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ELECTRICAL WORLD AND ENGINEER.

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SIXTY YEARS OF THE TELEGRAPH.

The past week has witnessed the sixtieth anniversary of the electromagnetic telegraph, it being May 1, 1844, when Prof. Morse was able to demonstrate the use of his invention in reporting at Washington the proceedings of the Whig Convention at Baltimore. Since that time the history of the telegraph in this country and elsewhere has been one of steady advance and of universal benefit. It is certainly a moot question whether of late years the telegraph has advanced as rapidly as it might have done, and whether it has not become more or less crystallized and fossilized in its apparatus and methods. Yet even this statement must be made guardedly, for while the great telegraph systems the world over appear to look askance on automatic and machine methods, the wireless telegraph inventions have been generally taken up and pushed with great success; and if there is anything more wonderful and stimulating in the domain of electrical advance at the present time than the wireless we do not know what it is.

The amount of service rendered to the public by the telegraph sixty years after its practical inception may be gauged from the fact that in only four or five of the leading countries, 400,000,000 or 500,000,000 authentic messages are dispatched annually exclusive of those handled by leased private wires. In this country the record is now probably about 100,000,000 a year, while Great Britain does not fall very far behind that. Germany and France together are good for another 100,000,000, while Russia, Italy, Austria and Spain will probably account for another batch of equal magnitude. The telephone to-day has asserted for itself the function of knitting closely together the various communities in which it is used, but it is still the proud boast of the telegraph and the submarine cable that they have been the great instrumentality in annihilating distance, promoting intercourse and commerce and bringing the nations together.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION

We are very glad to be able to present on another page the programme of the National Electric Light Convention, to be held in Boston at the end of this month. President Edgar and the officials are to be congratulated upon the excellent list of papers they have secured. In fact, it is a matter for wonder how they expect to get through it in the brief time available, for so far as we can judge, it far exceeds anything the Association has attempted for years past. The programme of entertainment is also very alluring, and there is no question as to the warmth of the welcome which awaits the electric lighting fraternity at Boston this month.

It is rather remarkable that the Electric Light Convention has not been held in Boston since 1887. A great deal of water has run under the bridge since then, and it was certainly high time that the Association visited again a city of so many attractions—from whatever standpoint it be regarded. The early Brush arc lighting work done there by the late Mr. Gilbert will not soon be forgotten; the fact that Boston was so long the headquarters of the Thomson-Houston Company gave it special importance for many years, while of late the aggressive and intelligent work of Mr. Edgar has made the city the center of remarkably rapid development and improvement in the applications of electric light and power. Altogether a better choice of convention city could not have been made, and we venture to be-

lieve that the convention will be one of the largest and best that the Association has ever conducted.

LARGE ELECTRICAL MANUFACTURE.

We publish elsewhere in this issue a synopsis of the annual report of the General Electric Company just issued. It is naturally a most interesting document, and in its fullness of detail may well be commended as an example of the kind of statement to which the public is entitled respecting the affairs of industrial corporations whose stocks are quoted on the exchange. The General Electric Company, in spite of the slackness and dullness of last year, enjoyed wonderful prosperity, with gross receipts reaching nearly $43,000,000, or more than $4,500,000 above those of last year. At the same time the net earnings were by no means so high, amounting after payment of interest on debentures to $7,789,300, against $10,232,800 in the preceding year. There were various reasons for this, but it may be noted also that the amount of orders billed was also nearly $900,000 less. The company in the last ten years has written off nearly $12,000,000 on its factories and carries them now at $6,500,000, which is extremely conservative. As a matter of fact, the company would appear to be doing about 25 per cent. of the entire electrical manufacturing of the country, and of course a very much larger percentage of that which falls within its own special fields. Moreover, the net profits of the year before writing off depreciation were equal to over 22 per cent. on the stock and 18 per cent. after charging off depreciation. Many of the details given in our synopsis, as well as in the full document, are of great interest and suggestiveness, particularly the items with regard to power transmission, the development of the multiple-unit system, the introduction of the steam turbine and the equipment of steam railroads with electricity. Some idea of the expansion of the company's business may be inferred from the fact that as recently as 1901 the gross receipts were below $30,000,000. Within the three years they are nearly half as much again.

OUR PATENT SYSTEM.

We are glad to publish the important suggestions of ex-Commissioner of Patents Seymour on reform in our present system. In justice to ourselves, however, we must correct some apparent misconceptions. In the first place, we have, and have freely expressed, a very bad opinion of "working" as customarily practiced. It is a solemn farce in most cases and does not serve to protect the public. The plan which we have advocated is a very different process of elimination. It practically makes the original issue for a short term subject to extension for suitable cause. The patentee at the end of, say, six or seven years, would have to come forward and show either that the invention was being so manufactured as to meet public demand fully and squarely, or in default of such working that there was complete and adequate cause for the default. In the hypothetical case of a patented torpedo boat cited by Mr. Seymour, the inventor would have to show that he had diligently and in good faith prosecuted the invention, endeavoring to procure its adoption and manufacture. If it had been steadily turned down by all those who had investigated it, it would be safe to conclude that it did not possess such merit as would warrant an extension. There are many inventions which require large expenditure for reduction to practice, and in all such cases the inventor should have the benefit of the doubt, but such cases form a very small proportion of the total of unused patents. Most of these are either without merit in a commercial sense or are obstructive patents held by the owners, generally large corporations to prevent competition at the hands of rivals. All these ought in the public interest to be extinguished once for all.

We are well aware of the provisions of the law in the case of prior publication whether in an expired patent or elsewhere, but there is a vast difference between falling afoul of these and infringing a patent in being. The latter, whether of public use or not, holds all improvements tributary and hence discourages them, while the former only serve to obstruct broad claims. Every large corporation holds patents which it does not use nor intend to use, but which serve to prohibit improvements along similar lines. As a matter of justice to the public, the whole crew of useless or shelved patents ought to be put out of the way, and we know of no more effective way of doing it than by requiring the owners to show just cause for an extension of term. Mr. Seymour's comments on the compulsory licenses are to the point, but they do not go in our judgment quite far enough, since they compel the public to pay tribute for a right which the owner does not himself deign to use. The poor inventor does not need to be clubbed into giving a license. If compulsory license is needed anywhere, it is in behalf of improvements blocked by earlier patents, used or unused. We heartily agree with Mr. Seymour in the necessity for more care in the Patent Office searches with respect to novelty, and in his appreciation of the need for greater liberality in the case of broad inventions, hitherto only patentable in detached segments sometimes very hard to protect singly. In fact, we think the office overhauling of applications should be so thorough as to bar lack of invention as a defense in infringement cases, and to make anticipation very difficult to establish. But the public needs protection against the use of patents to obstruct improvements. There is a deal of Buncombe over justice to the struggling inventor, for that needy person has generally sold his birthright for a mess of pottage long before the invention has come into common use; and a show-down of ownership in patents of actual or potential importance would disclose most of them in the hands of sleek promoters or of corporations using them to minimize competition from improvements. This is commercially legitimate, but it is far from the primary purpose of a patent system.

MUNICIPAL IMPROVEMENT LOANS.

We note that several of the English financial authorities are calling attention to the grave position of municipal credit in the British Isles and expressing concern over the heavy strain that principal corporations are undergoing in their efforts to meet the enormous liabilities imposed upon them by the various trading operations upon which so many of them have launched. The London *Argus* enumerates some instances of the kind, and mentions the fact, as an example, that all the Birkenhead loans are at a discount. Glasgow, which runs everything for itself, including the cradle and the grave, is offering a half per cent. over the deposit rate of the Scotch banks on loans for a month. In no fewer than 18 large municipalities the 3 per cent. loans that eight years ago were at a premium are now at a discount, and appeals are being made right and left for loans even in small sums, predicated on mortgages of corporation revenues. In London, where all kinds of enterprises have been indulged in, some electrical, a halt has been called, and none too soon. It is bad enough to have a score or two of nations load themselves with debt in order to destroy each other's savings by bloody warfare. It is worse to have hundreds of municipalities plunging headlong into crazy financing and obligation, the sole object of which is to check and choke the enterprise and thrift of their own citizens. There is as little excuse for the one form of borrowing as for the other.

The indebtedness of local authorities in the United Kingdom has nearly doubled in ten years, and in 1902 was already $2,000,000,000.

Terrific as these figures appear, we can match them in the United States, although the sturdy individualism of our people has not yet yielded so fully as that of the European to the rule of others mightier than ourselves which makes for bankruptcy. We have lots of cities with a debt of over $10,000,000. Boston and Philadelphia have both over $50,000,000. Chicago has but $15,000,000, yet is always hard up. St. Louis has nearly $25,000,000. But these figures are child's play alongside the returns from Gotham. The budget for 1902 for Greater New York City provided over $23,000,000 for interest and redemption of city debt, and since then it has been piled up higher and higher. Some enthusiastic New York socialists would like to throw away several hundred millions more even now on lighting plants and trolley lines; but there is a limit, and there will soon be a sharp jolt and halt. The *World's Work* points out that the city budget is bigger than that of any five other cities in the country; that the city employs 46,000 persons, and that it pays wages and salaries amounting to $55,000,000 a year, at the highest rates known in the vicinity. Well may the magazine we quote say: "No company or private business could afford such a drain upon its resources." We are no alarmists. The strong, healthy optimism of American growth is ours, but we do not hesitate to say that such exhibitions of the unmitigated tendency to have the municipality do everything, and to put every citizen in buttons is both dangerous and disgraceful to our nation.

AMERICAN INDUSTRIES AND THE METRIC SYSTEM.

The National Association of Manufacturers has recently published in a supplement to *American Industries*, for April 15, 1904, a detailed analysis of replies elicited by a circular letter addressed at the end of last year to about 2,800 members of the Association, on the subject of the metric system bill. The tone of the circular letter shows that the circular letter was devised in a spirit of antagonism to the metric system, and that its purpose was to elicit as far as possible the hostile sentiments of the Association members towards the metric system bill, which, as drafted in 1903, contemplated compulsory adoption of the system by the United States at large. Consequently, while there is no reason to suppose that the Association management has in any way misrepresented the returns to the letter, it seems probable that the tone and purpose of the letter have elicited the greatest hostility that the bill can evoke from the membership, and that if a circular letter had been drawn up in the opposite spirit of eliciting as far as possible the favorable spirit of the membership towards the adoption of the metric system in some manner, as distinguished from compulsory adoption at the date of January 1, 1907, a much more favorable set of returns for the metric system might have been looked for. Nevertheless, the results published are very encouraging, and we owe our thanks to the National Association of Manufacturers for their pains in issuing the letter and in tabulating the published returns.

It seems that 774 replies were returned, or from about 36 per cent. of the members addressed. Eleven questions were asked in the letter. There is no fault to find with these questions, considered independently of the letter accompanying them. We need only consider the last question, which was: "Should the metric system be made the legal standard of the country?" There are 707 recorded answers tabulated for this question, and 141 were affirmative, 87 were noncommittal, and 479 negative. This means that 20 per cent. of the answers as tabulated were in favor of the metric system as a legal standard, and 67.7 per cent. were against the metric system. Broadly speaking, therefore, two-thirds of those who voted, voted against the metric system, while one-fifth voted for it. The percentage in favor of the metric system as a legal standard in the tabulated return is 25.5 per cent. in the metal group and 15 per cent. in the non-metal group of manufacturers. It reaches a maximum of 32 per cent. among manufacturers of electric machinery, and is lowest in boots (4.5 per cent.). The boot industry is clearly wedded to the English foot. So far as the favor of the metric system in industry is concerned, it seems that electricity is at the head of the procession.

Altogether, the result is very encouraging and satisfactory, from the standpoint of international unity of weights and measures. Ten years ago had such a ballot been taken, the returns in favor of the metric system would probably have been only about 5 per cent., and evidences are abundant that the metric system makes steady progress towards favor. Three engineering societies are down as favoring the bill; namely, the Boston Society of Civil Engineers, the Engineers' Society of Western Pennsylvania and the Western Society of Engineers. We know at least three more among the most prominent in the country that might have been included in the list if they had been consulted, their pro-metric votes having been officially published. Seven engineering societies are tabulated as against the measure. Among commercial associations, 9 are down as in favor of the bill, and 14 against it. Among manufacturers' associations, 2 for and 21 against. If the same incompleteness of returns exists in the two latter classes as we know to exist in the first class,, material changes in these numbers might also be looked for. But the result of any canvass of the metric system among manufacturers is necessarily a limited criterion of the value of the system to the country at large, and even of its ultimate value to the manufacturers themselves. In these days of keen competition, a profitable business implies a skillful adjustment with respect to numerous factors, and a favorable balance sheet is the question of the hour, not of the distant future. Opportunism is thus almost necessarily the guiding policy in manufacturing, and even though personally recognizing the intrinsic merits of the metric system, a manufacturer as such is apt to view its adoption only in the light of involving an expense without prospect of any immediate return, and as menacing a delicately balanced factory organization.

ELECTRICAL METHODS OF DETERMINING TORQUE.

There are various well-known methods of measuring torque mechanically. For example, a pair of pulleys set independently side by side and connected by a spring or springs, enable the torque communicated from one to the other to be measured, during rotation, by the distortion of the springs. Every mechanical transmission dynamometer is, in fact, a torque measurer. The electric motor is generally considered as the most convenient and reliable transmission dynamometer, since the power transmitted is capable of being readily measured in watts, and this power, divided by the angular velocity of the motor shaft, in radians per second, gives the torque at once in dyne-centimeters, and thus, by conversion, in pounds-feet or other desired unit. The method is very convenient, and its accuracy is limited only by the accuracy of the wattmeter and of the speed measurer. Prof. McAllister's article on page 871 refers to a refinement in the method of torque measurement by the use of the shunt electric motor. The refinement consists in the elimination of the extra torque to the conditions of measurement, such as that due to the belt connection between the machine to be tested and the shunt machine, which gives the measurement. The shunt machine first drives both machines, taking from its mains the power required to overcome the frictions of both. Next the machine to be tested takes power from its mains and assumes a share of the load, the amount of its load being adjustable. The change in the current of the shunt machine measures the mechanical torque exerted by the tested machine. That is to say, the formula yields the torque which the tested machine gives to its shaft and bearings, after paying for internal electrical and mechanical frictions.

Programme of the National Electric Light Convention.

The following is the programme of papers and reports to be presented at the twenty-seventh convention of the National Electric Light Association, to be held in Boston May 24, 25, 26 and 27:

"The Sale of Electrical Energy," W. F. White; "Economy Test of a 5,500-hp, Three-Cylinder Compound Engine and Generator," J. D. Andrew and W. F. Wells; "A One-Hundred-Mile Transmission Line," Robert Howes; "The Mechanical Stoker and the Human Operator," Edwin Yawger; "The Organization and Equipment of an Arc Lamp Department," Samuel G. Rhodes; "Practical Notes on Steam Turbines," Francis Hodgkinson; "Electric Light and Power Plants in Connection with Ice Plants," C. L. Wakefield; "Single-Phase Power Motors for Electric Lighting Stations," W. A. Layman; "A Three-Wire, 500-Volt Lighting System," Walter I. Barnes; "Notes on the Internal Combustion Engine as Applied to Central Station Service," E. E. Arnold; "A Proposed System of Standard Instruments for Operating Companies," H. P. Davis; "Remote Control of Electrical Apparatus," William H. Cole.

In addition to these papers, which are already in print, are three or four others on timely subjects which have not yet gone to press, among them one by Dr. F. A. C. Perrine, on "Types of Large Water Power Installations." The reports are as follows: Report on Progress, T. Commerford Martin; report of Committee on District Heating, E. F. McCabe, chairman; report on Lost and Unaccounted-for Current, C. W. Humphrey; report on Purchased Electric Power in Factories, W. H. Atkins, chairman; report on Office Methods and Accounting, Frank W. Frueauff; report on Advertising, La Rue Vredenburgh; report on Sign and Decorative Lighting, Arthur Williams; report on Analysis of Flue Gases, Henry L. Doherty, chairman; report on Standard Rules for Electrical Construction and Operation, Capt. William Brophy, chairman; report of Committee Appointed to Investigate the Steam Turbine, William C. L. Eglin, chairman; Wrinkle Department, edited by Charles H. Williams; Question Box, edited by H. T. Hartman. There are 100 or more "wrinkles" submitted, and the Question Box contains nearly 450 questions, nearly every one of which has been answered. In addition to the papers above enumerated will be the paper on "Underground Construction," for which Past President Doherty will present a gold medal.

The following-named gentlemen comprise the local entertainment committee: James I. Ayer, chairman; Prof. C. A. Adams, Albert Anderson, William H. Atkins, F. E. Barker, F. P. Barnes, R. N. C. Barnes, George H. Berg, H. Bottomley, Capt. William Brophy, F. E. Cabot, C. W. Cartwright, A. E. Childs, A. T. Clark, Prof. Henry E. Clifford, D. P. Robinson, Charles B. Davis, George C. Ewing, H. H. Fairbanks, H. C. Farnsworth, George H. Finn, Almon Foster, W. C. Fish, Charles J. Hatch, Percy Hodges, W. E. Holmes, G. W. Holtzer, Sydney Hosmer, P. J. Kennedy, A. H. Kimball, George B. Lauder, F. W. Lord, Emil C. Lundin, Norman Marshall, E. H. Mather, Everett Morse, H. W. Moses, W. L. Mulligan, J. H. Parker, H. S. Potter, C. B. Price, C. F. Pritchard, Andrew Raeburn, F. H. Raymond, F. S. Richardson, S. B. Condit, Jr., Frank Ridlon, F. P. Royce, G. L. Sadler, F. S. V. Sias, F. E. Smith, Prof. H. B. Smith, J. A. Smith, J. Brodie Smith, George R. Stetson, F. J. Stone, G. M. Stuart, La Rue Vredenburgh, Thomas C. Wales, R. L. Warner, N. T. Wilcox, S. B. Wetherbee, F. S. Wilson, W. C. Woodward.

The following programme will be carried out for the entertainment of the visitors: On Tuesday afternoon the ladies in attendance will take carriages and drive through the Fenway and possibly to some points of interest about Boston. Committee, Charles J. Hatch, W. E. Holmes, D. P. Robinson. On Tuesday evening there will be given at Hotel Vendome a lecture on "Historical and Electrical Boston," under the charge of La Rue Vredenburgh. On Wednesday morning the ladies will visit the shopping district. Committee, H. S. Potter, F. S. Wilson, F. S. V. Sias. On Wednesday afternoon there will be a trip down the harbor, and on return a visit to the L street station of the Boston Edison Company. Committee, Sydney Hosmer, Percy Hodges, W. C. Woodward, Prof. H. E. Clifford. Wednesday evening will be spent at Symphony Hall, attending a popular concert. All the space within the rail has been reserved for the use of the guests and their friends. Committee, R. L. Warner, Thomas C. Wales, R. N. C. Barnes, George C. Ewing, F. W. Lord. On Thursday there will be provided for the ladies a trip in automobiles to Wayside Inn, Lexington and Concord. Committee, C. B. Davis, George H. Berg, F. S. Wilson. On Friday the entire day will be devoted to personally-conducted trips in and about Boston. The business sessions of the association will close on Thursday evening, leaving Friday to be devoted purely to entertainment in the manner above outlined.

A general information bureau will be established at Hotel Vendome, in charge of Messrs. Vose and Peasley, and in addition to the usual duties that such a bureau is called upon to perform, it is intended to have during the week lists made of those desiring to take any particular trips or see any particular points on Friday, so that adequate arrangement may be made for properly personally conducting the visitors to such places as they desire to go.

Mr. W. H. Atkins will have general charge of the entertainment on Friday, and the following committees have been selected to arrange details for the excursions as listed below: Institute of Technology, Prof. H. E. Clifford; Harvard University, Prof. C. A. Adams; Bunker Hill Monument and Navy Yard, P. J. Kennedy; Fore River Ship and Engine Company, Charles H. Parker; Simplex Electric Company, Everett Morss; Holtzer-Cabot Electric Company, C. W. Holtzer; power stations, Boston, I. E. Moultrop; trolley trips, Paul Winsor; N. E. Gas & Coke Company, George H. Finn.

The above briefly outlines the general plan, more definite details of which will be incorporated in the programme, which will be printed a short time in advance of the meeting.

Underwriters to Investigate Fire Causes.

The announcement is made that the National Board of Fire Underwriters—a body comprising about 120 of the most important fire insurance companies, doing business in the United States (which companies have paid out in losses in this country during the last ten years over $750,000,000, not including the recent conflagrations in Baltimore, Rochester and Toronto)—being thoroughly aroused by the continued great and apparently unnecessary fire waste of this country and especially the frequency of sweeping conflagrations in recent years, has undertaken to carefully investigate conditions existing throughout the country, in order to determine if possible more accurately than heretofore, where conditions exist which are conducive to the origin or spread of fire and to co-operate with the government—Federal, State and Municipal—by suggestions for the elimination of such conditions in order to check the present destruction of property so impoverishing to the nation and its citizens.

To carry out this object, a committee has been appointed, known as the Committee of Twenty of the National Board of Fire Underwriters, with instructions to define the congested districts of cities and determine their conflagration hazard, and for that purpose this committee is now organizing a staff of fire protection engineers, who will, after careful inspection, make reports on the construction, fire protection, electric hazard and other local conditions of cities, so that recommendations may be made for the adoption of better building laws, the improvement of water supplies and fire departments and the general safeguarding of hazards including electricity, handling of explosives, etc., etc.

For this work the committee will employ a number of men having had a technical education or training in the different branches of engineering which may fit them for work in such a cause. It is believed that the importance of this work will rapidly increase and that this engineering bureau will be a permanent adjunct of the national board. Men of ability, graduates of technical schools, will, therefore, probably find in such work an agreeable field for their ambitions, especially as few men at the present time have entered the profession of fire protection engineering, in which there seems to be such a promising future. Application blanks for employment on this corps of engineers have been prepared by the committee and can be procured by addressing Mr. Herbert Wilmerding, secretary of the committee, 46 Cedar Street, New York.

Submarine Boat for Japan.

It is reported from Bridgeport, Conn., that the Japanese Government has practically purchased the Lake submarine torpedo boat *Protector*. It is stated that both Russia and Japan made offers for the vessel, but Japan outbid her rival. The *Protector* is now at Newport, R. I.

The Snoqualmie Falls and White River Power Developments.

THE newly organized Snoqualmie Falls and White River Power Company, capitalized at $3,000,000, has acquired by purchase the properties of the noted Snoqualmie Falls Power Company, the Seattle Cataract Company and the Tacoma Cataract Company.

The Snoqualmie Falls Power Company was the pioneer long-distance transmission company in the Pacific Northwest, having a developed capacity of 11,000 hp, which has been in operation three years.

The power generated at Snoqualmie Falls has been distributed through the agency of the Seattle Cataract Company and Tacoma Cataract Company. These two companies owned the franchises and the right to sell Snoqualmie power in the two cities, respectively. They owned the large and handsome sub-stations at these points and the distribution systems throughout the cities, and they marketed the product of the generating plants.

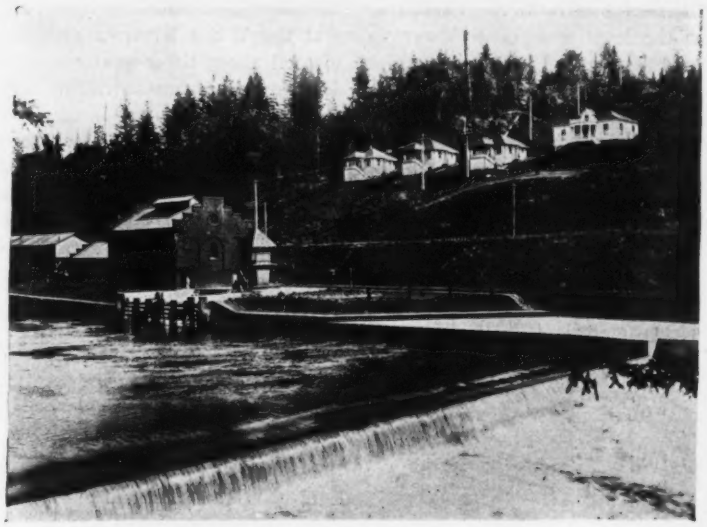


FIG. 1.—GENERAL VIEW AT THE FALLS.

There has been an unprecedented demand for the power generated by the Snoqualmie Falls Power Company. Indeed, this company, both from the viewpoint of the electrical engineer and of the financier, has been an unqualified success. The company's gross earnings have been at the rate of $244,000 a year, and although its prices have been most moderate, its net earnings have been $120,000 per annum, which will be more than doubled after additional capacity is installed. Snoqualmie power is turning the wheels of the many factories and workshops of Seattle and Tacoma, and is running the trolley cars of Seattle, which carry 40,000,000 passengers annually. It supplies power to the Puget Sound Railway Company, commonly known as the "Interurban," which conveys more than a million people between Seattle and Tacoma yearly, and to the Seattle & Renton Railway Company, which carries 1,140,000 passengers annually.

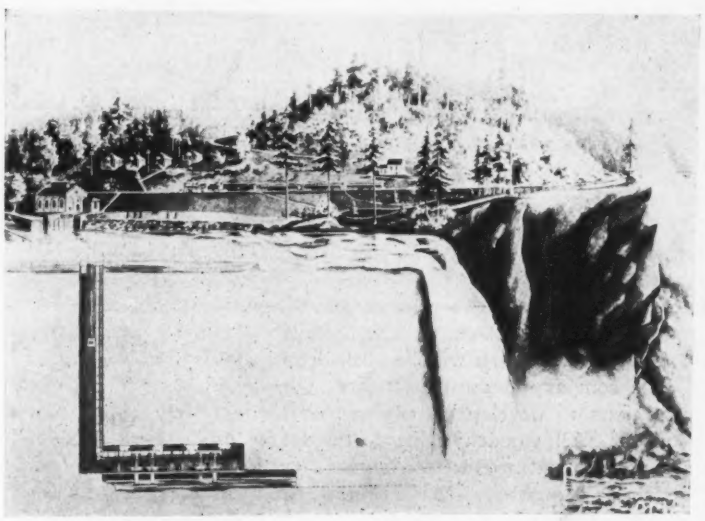


FIG. 2.—SECTIONAL DRAWING OF HEAD WORKS.

To mention divers uses, this power grinds 9,000 bushels of wheat a day at the Centennial Mill and 2,200 bushels at the Hammond Mill, both of which plants are located in Seattle, treats 650 tons of ore a day at the Tacoma Smelter, and runs dentist's burrs in Seattle and Tacoma. It furnishes power for the Washington Iron Works Company, the largest industry of this sort in the Pacific Northwest, and for the Metropolitan Press, of Seattle, which prints most of the papers and periodicals published in this part of the country. It grinds spices and roasts coffee for the Crescent Manufacturing Company, and is the motive force of the Washington Shoe Company, which sends its products all through the Northwest and Alaska. Among other large users of power are the Seattle Electric Laundry, the flour and feed mill, operated by Lehman Bros. in Seattle, and the Tacoma Mill and Fransiola Mill in Tacoma, the hay presses and large feed mill of the Galbraith-Bacon Company and the smelting works and machinery of the large jewelry factory of Joseph Mayer & Bros., of Seattle.

Snoqualmie current furnishes light to the American Steel & Wire Company, for all of the Seattle tracks of the Northern Pacific Railway Company, and runs the motors of its machine shops; to many of the public buildings, stores, saloons and offices in Seattle and Tacoma; and it operates the motors of the numerous small industries of both cities.

Current is supplied to Renton, Kent, Puyallup, Sumner, Swansea, Issaquah and Auburn; and the two last-mentioned cities also obtain their street lighting from this source. Besides supplying Tacoma with most of the power and light for its factories, stores and residences, the Snoqualmie Company also has a contract for the entire city lighting, concerning which the Mayor of Tacoma recently wrote to Mr. Charles H. Baker, president of the Snoqualmie Falls Power Company. "If, throughout your five-year contract with the city, you continue to supply this character of current, you will greatly benefit the city and retain the advanced position you now hold."

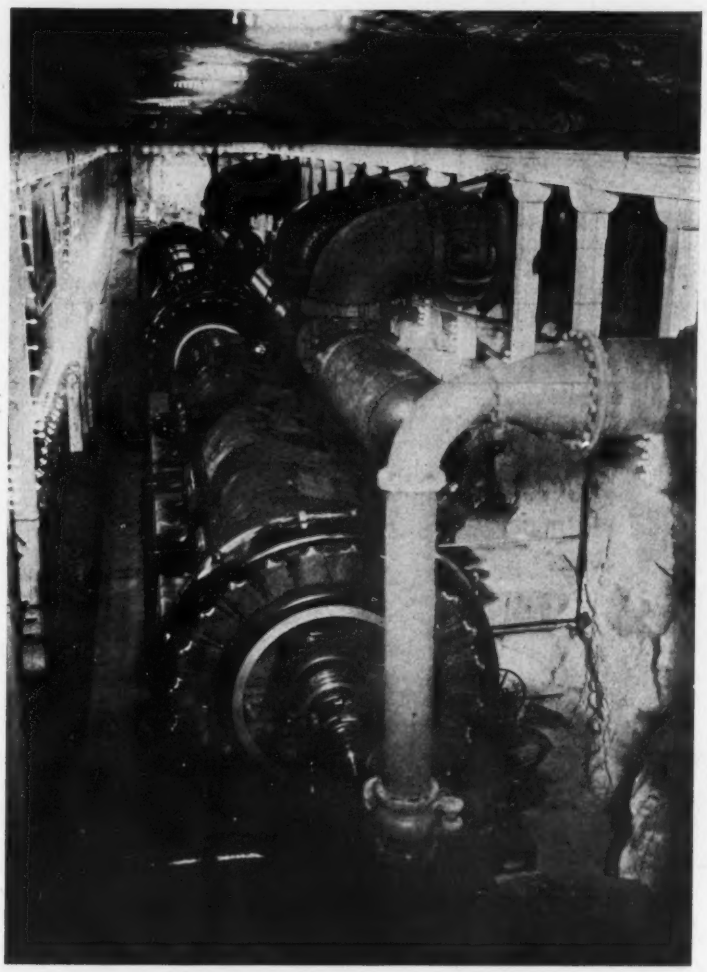


FIG. 3.—UNDERGROUND POWER STATION.

Snoqualmie power is also being used by the Great Northern Railway Company in the construction of the important tunnel which it is carrying under the heart of Seattle in order to get its trains off of the main waterfront street of the city, and will light the tunnel both during the creative period and after it is in operation.

Mr. Charles H. Baker, who, in connection with his father, the late William T. Baker, promoted and built the Snoqualmie plant, has taken upon himself an entirely new promotion and development, in harnessing the water power of White River. For this purpose he has organized the White River Power Company, of which he is the chief engineer, and the active manager of its constructional operations. Mr. Baker's Snoqualmie plant is already overloaded owing to the rapid development of the Puget Sound country, and he, therefore, expects to find little difficulty in marketing the product of his White River Company, which already has applications for a considerable portion of its initial capacity. The White River power plant will supply current to the same sub-stations that the Snoqualmie plant does in addition to such new points of distribution as may be determined upon, the radius of profitable distribution being 250 miles in this territory already abundantly supplied with cheap coal and wood fuels. The White River Power Company was formerly owned by the Westinghouse Electric & Manufacturing Company, of Pittsburg.

It is now generally conceded that Snoqualmie River and White River afford the best commercial water powers tributary to the Puget Sound communities. While there are numerous streams in this section of the country—and any stream which has positive direction of flow may theoretically be a water power—yet practically it is unsafe to consider any stream as a commercial possibility unless its volume at minimum flow is ample and unless Nature has, figuratively speaking, done most of the work in the proposed power development, as in the case at both the Snoqualmie and the White River plants. It must not be lost sight of that Puget Sound already affords the cheapest fuels in the world for power in the shape of nearby coal and wood, and the first serious point to be considered by the hydraulic engineer, therefore, in order to protect investors is whether the proposed water power can successfully compete in cost. It is the careful consideration of this condition which bars nearly all the rivers and the streams in the Northwest from having significance as power possibilities. Streams which must be discarded for consideration in Puget Sound, would, if they could be shifted to other fields like California, Nevada and the Central States, where fuels are high, become important industrial factors and wealth producing agencies.

In the foothills of the Cascade Mountains, under the shadow of the snow-capped peak of Mt. Rainier, the White River Power Company is constructing a power plant which is destined to play a very important part in the development of that country, wonderfully rich in natural resources, lying between Portland, Ore., on the south, Vancouver, B. C., on the north, the Cascade Mountains on the east and the shores of Puget Sound on the west. Utilizing the water power of White River, a glacial stream having its source in Mt. Rainier, the company is constructing near Sumner, Wash., a power plant having a capacity of 50,000 electrical hp, of which 10,000 hp will be ready for distribution within one year's time. It will be unequaled in America in size, simplicity and first cost. The varied and multiple uses to which the Snoqualmie power is now being put give, however, only a hint of the demand that exists for electric current in the rapidly-growing section which will be fed by the White River Power Company.

The territory covered by the construction crews of the White River power development extends from Buckley (elevation 660 ft.) in the foothills of the Cascades to Sumner (elevation 65 ft.) lying in the level and fertile lower valley at the White River, a distance of ten miles. The headworks are located about three-quarters of a mile above the Northern Pacific Railway Company's trestle over the White River at Buckley. A concrete dam is being built across the river 9 ft. high and 500 ft. long. This dam will be provided with a sluice gate and automatic flash boards, which will eliminate injury to the dam from floating logs during the periods of high water. An intake 120 ft. wide, located on the south bank of the river, will lead the water into the first section of an open

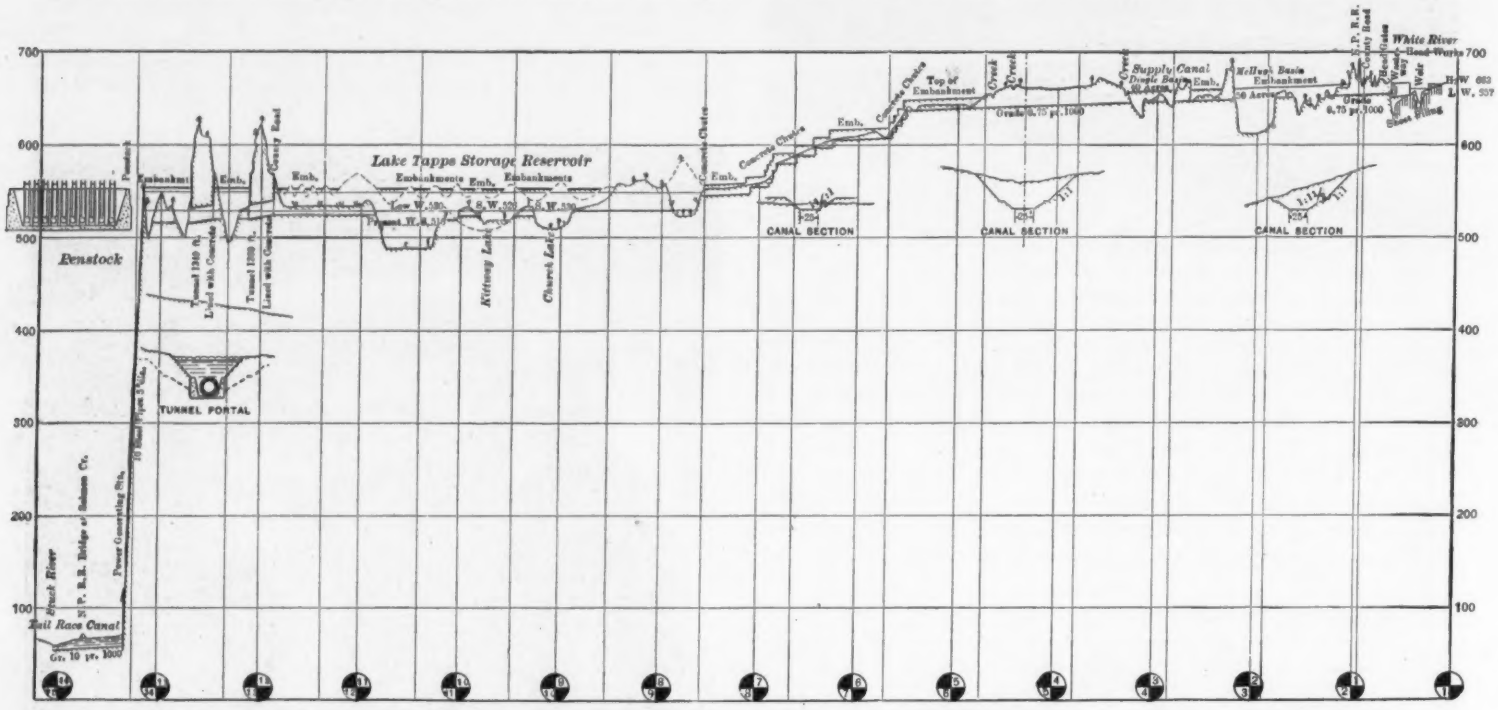


FIG. 4.—GENERAL PROFILE OF SNOQUALMIE HYDRAULIC DEVELOPMENT.

canal. This canal, which is 50 ft. wide and is 5 miles long from the intake to the storage basin at Lake Dorothy, follows an old channel of the White River; and owing to this provision by Nature of a ready-made canal site, it will not be necessary to build flumes at any point of the entire length of the construction work. By the use of four of the largest steam shovels obtainable and 1,500 men this part of the work will be pushed to a speedy conclusion.

The company is most fortunate in being enabled by the natural conditions to develop an engineering plan entirely eliminating all fluming. All wooden flume features are a disastrous attribute of any power plant, particularly where there is not an extensive storage system as a guarantee of continuous service. The Bakersfield plant in California, which depended upon a two-mile flume, found the service so unreliable on account of the land slides and rock slides taking out the flume, that it penetrated a mountain with a two-mile tunnel through solid granite in order to abandon the flume construction. The longer the flume, the greater the liability to disorders.

The White River plant and the Snoqualmie plant have practically the same elevation of intake, viz.: 660 ft. above sea level. This is a most fortunate situation, for if they were any lower it would be at the expense of head, and any increase in elevation would proportionately reduce the area of watershed and particularly of the

rain-fed portion of the watershed. It must be remembered that the Puget Sound rivers derive their winter flow from rains and springs, and their summer flow from snow and glaciers. The higher the intake elevation, therefore, the less the rain area controlled, and consequently the less the power capacity of the river for winter service. Under the load conditions in Seattle and Tacoma, the power requirements are thirty-five per cent. greater in winter than in summer, and the flow at the Snoqualmie and White River intakes responds to these conditions. Another favorable feature of the White River watershed is that the snow and glacier portion of it faces the north, and being thus sheltered from the hot summer sun, the melting is more gradual and later in the year, thus promoting a higher low water stage in the late summer. The Puyallup and Cowlitz glaciers lying upon the southern slope of the mountain disappear much earlier, so that these rivers suffer a more marked and protracted summer low water proportionately.

The first 1,300 ft. of the canal is being excavated along a side

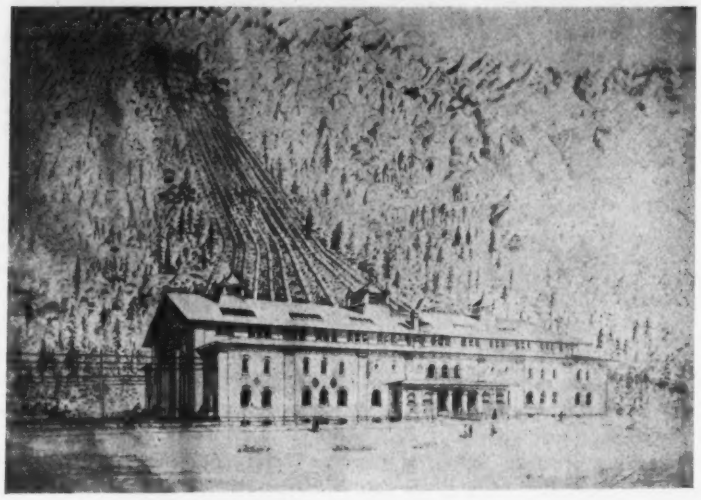


FIG. 5.—WHITE RIVER POWER HOUSE.

hill and will be lined with rubble stones. At the bottom this part of the canal is 25 ft. wide with slopes of ½ to 1, and the water will have a depth of 10 ft. From this point the canal, lined with concrete, crosses the county road, which will be bridged, and tunnels the embankment of the Northern Pacific Railway. Then the canal passes on to a series of alternately narrow and broad benches, which at some remote period formed the bed of the White River itself. These benches are open on the north, the river side, and sloping towards the south they are surrounded on three sides by a higher bench forming the flat part of the main land or plateau. The geological formation of the country, through which the canal passes, is cement and boulder gravel. On this foundation will be deposited by the natural action of the water the white sediment, from which the river gets its name. This sediment is a glacial silt, formed by the scraping of the glaciers of Mt. Rainier on the rock, and its characteristics are such that after it becomes caked it is practically as impervious to water as rubber. By the use of this substance the seepage of the canal will be reduced to a minimum at the outset, and it is expected that within two or three years it will be entirely eliminated.

The elevation of the intake was so established that it made it possible to lead the canal into four lakes—respectively, Hart Lake, of 8 acres; the McHenry Lake, of 68 acres; the McHugh, of 11 acres, and the Campbell Lake, of 35 acres. In order to supplement the work of Nature it will only be necessary to build several low embankments, the material for which will be furnished by the earth taken from short cuts between the respective lakes. Like the canal these lakes will be rendered water-tight by the deposits of glacial silt. In them the white sediment will be made to settle in order that none of the silt shall be carried into the storage basin at Lake Dorothy.

After leaving the settling basins the water is carried from the intermediate bench through a cut to the high bench, and from this point traverses the main flat country in a westerly direction for 3½ miles until it reaches the Lake Dorothy storage basin. This section of the canal is 100 ft. wide on the surface and 50 ft. wide at the bottom, with slopes of 2 to 1; the depth of water will be 11 ft. To utilize the settling basins, previously mentioned, the location of the intake was so determined that the canal emerges at an elevation of 100 ft. higher than the storage basin. This difference in level will be overcome by guiding the water down over successive chutes to the storage basin. Had the intake been placed so as to avoid the use of these chutes, the canal would necessarily have had to be built along the steep side hills of the White River canyon, thereby entailing the construction of several miles of flumes, a structure that would have been enormously expensive in first cost and maintenance and neither permanent nor reliable.

The White River, while glacial in its origin, is also largely fed by rain and melting snow. During the winter the flow of water is the largest, for it is rarely cold in this part of the country for any length of time, and the warm Chinook winds cause the snow falling on Mt. Rainier and the Cascades to melt rapidly. The floods vary with the precipitation of snow and rain, but the highest flood recorded is 60,000 c.f.s. Only in one month of the year is the flow less than 2,000 c.f.s., the quantity required for the operations of the company on a basis of 120,000 theoretical hp. In October the flow drops as low as 600 c.f.s., and all of this will be taken with the exception of 30 c.f.s., which the federal law requires shall be left in the river to keep the fish alive and for domestic use. During the other months of the year the control gates of the intake will admit only the 2,000 c.f.s. needed to run the company's water wheels.

Through the magnitude of the Lake Dorothy storage basins, however, the company will always have in reserve a vast volume of water for the use of its generating station, which will be constructed in the White River valley, near Sumner below the storage basins. This basin is the most important feature of the whole plan of the White River Power Company, as it is the largest storage basin controlled by any power company in the United States, being only exceeded in capacity by the Great Lakes, which feed Niagara Falls. Another great advantage that this basin has is that it is situated directly over the station in which the water will be used for generating power.

FIG. 6.—VIEW OF TRANSMISSION LINE.

Its location, unlike that of some storage basin remote from the power plant, removes the supply of water from all uncertainties. By the time that the water has reached the storage basin, all dangers from logs and log jams, from breaks in the dam or in the canal or from other causes, are entirely obviated. The Lake Dorothy basin is, therefore, the principal factor in the undertaking of the company.

Until the White River Power Company secured the ownership of the territory surrounding the largest lake, which will be used for a storage basin, it was known as Lake Tapps, the present area of which is 620 acres. In its close proximity are three other lakes, respectively Kirtley Lake, of 80 acres; Church Lake, of 40 acres, and Crawford

Lake, of 20 acres. Like that of the canal right of way and the settling basins, the natural contour of the country around the storage basin is such that it might appear as if Nature intended these lakes for the purpose that the company now proposes to utilize them. The present elevation of Lake Tapps is 515 ft. above the sea level; Church Lake, 530 ft., and that of Kirtley Lake is 526 ft.; but work is now progressing on a series of embankments, making it possible to raise the level of Lake Tapps 35 ft., thus securing a water area of 4,000 acres, which is about seven times larger than the present area. The storage capacity of the Lake Dorothy basin, roughly computed, will be 5,227,200,000 cu. ft., as the average draw-down of water in the basin will be 30 ft. and this means 50,000 hp for two months.

The land controlled by the company, extending from Buckley to Sumner, comprises an area of 6,500 acres. Of this total area 4,000 acres are used for the storage basin, 120 acres are required for the canal and the three settling basins; the headworks cover an area of 10 acres; and the generating station and other buildings in connection with the power plant require 10 acres. A total of 4,140 acres will, therefore, be used in the actual operations of the power company. The balance, 2,360 acres, is controlled by the Lake Dorothy Improvement Company, a corporation organized under the laws of the State of Washington, and will be developed as a pleasure resort by that company.

The power company has a valuable asset in the vast quantity of timber standing on the lands that it has acquired. It has been estimated that the company owns 200,000,000 ft. of timber, 50,000,000 ft. of which is classed among the best cedar standing in the State, and there are over 100,000,000 ft. of fir in prime condition. The canal right of way and basins have been so commonly submerged by the high waters of the White River that forest fires have done very little damage to the timber. Therefore, taken as a whole it is in a better state of preservation than that in most of the sections of the State. To utilize this "by-product," the power company will erect a saw-mill in the White River valley, near the Northern Pacific Railway, which will have a daily capacity of 100,000 ft. It is expected that this saw-mill will be ready for use about the time that the power plant is in actual operation, which will be in one year's time. The output of the saw-mill will be disposed of in the open market, and will largely enhance the company's revenues.

As a result of the submersion of the ranches contiguous to the storage basin, which will be done as soon as the embankments surrounding the lakes are completed, the whole contour of the country will be very much changed. What are now little hills will then be islands, and the valleys between them will be covered with water. These islands and the shores of the lake, an area of 2,360 acres, are controlled by the Lake Dorothy Improvement Company for improvement purposes, which has before it an unparalleled opportunity of building up one of the famous summer resorts of the country. Nature has surrounded the field of its operations with scenery of marvelous beauty. The country, lying as it does in the foot hills of the mountains, is varied in character, commanding a wide view of the Cascade Range and of the fertile White River valley as well. The waters of Lake Dorothy will be studded with twenty-two islands of various sizes, but all of them large enough to be susceptible of improvement for summer residences and pleasure resorts. Lake Tapps now has, for a small lake, a widely diversified aspect, owing to the fact that it has many coves and several long arms, which afford abundant opportunity for exploration by the adventurous, whether in a launch or in a canoe. This feature of the lake will, of course, be greatly intensified when the waters of the storage basins are raised 35 ft., bringing about a seven-fold increase in its area. Owing to the fact that Lake Dorothy is only ten miles from Tacoma and twenty-four miles from Seattle, the principal cities of Puget Sound, it will easily be possible to make it a great summer resort. It is estimated that 50,000 people have visited the falls since the company secured the property which it controls. At Lake Dorothy it will be particularly easy to handle large crowds, as the main line of the Puget Sound Electric Railway now runs within two miles of the company's camp, making it necessary to construct only a short spur to reach the lake.

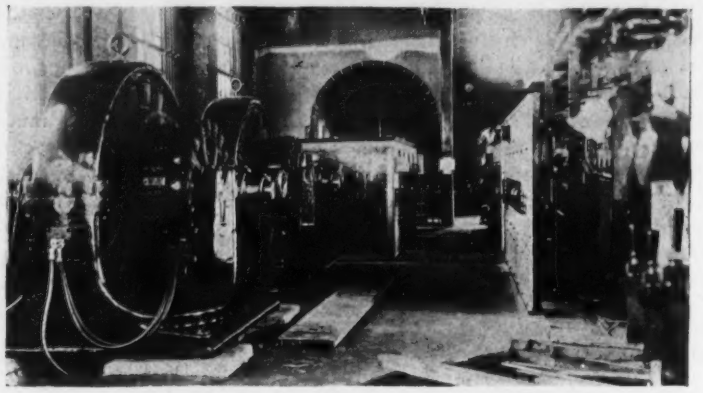


FIG. 8.—INTERIOR OF TACOMA SUB-STATION.

Besides erecting cottages, pavilions and the like, the company will construct a bungalow 68 by 52 ft. on one of the islands, which will be ready for occupancy next summer.

The generating station near Sumner, in the White River valley, will be housed in a two-story building, of which the main dimensions are 219 by 116 ft. This structure will be built of brick, stone and iron, so that it will be practically indestructible. In this building will be located, on the first floor, the office, a carpenter shop, a machine shop and a blacksmith shop. Railroad tracks run through the center of the station to facilitate the handling of the machinery. These will have a spur connection with the main line of the Northern Pacific Railway Company. A traveling crane of 50-tons capacity will be installed which can be operated with ease in any part of the building.

FIG. 7.—TACOMA SUB-STATION.

FIG. 9.—SEATTLE SUB-STATION AND OFFICE BUILDING.

Leading from the Lake Dorothy storage basin provision will be made for ten 48-in. pipes, which will carry water to ten water wheels operating ten generators of 5,000-hp capacity each. All of the electrical equipment of the plant will be of the Westinghouse type. The

water flowing through the penstock will have a net fall of 485 ft. Each bank of three transformers will be housed in a fire-proof compartment. On the second floor of the station will be located the high-tension and operating galleries and the switchboard.

The generators and transformers are connected for operating each set of transformers on their own generators, and also for operating a set of transformers on any generator for emergency cases. Under ordinary operating conditions the generators will be in parallel. Double-break oil switches having a vertical lift of the plunger will be used and will be operated by electric pneumatic control. Integrating wattmeters will be placed on each machine to record

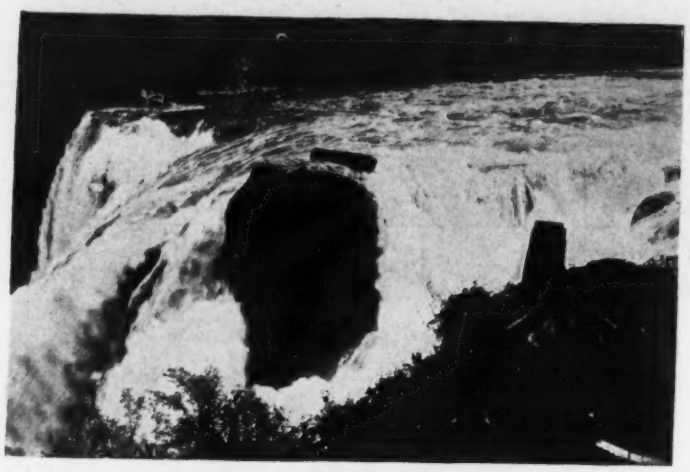


FIG. 10.—BRINK OF THE FALLS.

the total output. Lightning arresters will be connected to the line through switches controlled by electropneumatic cylinders from the switchboard, ammeters being placed in the lightning arrester leads to show when current is flowing through them. In the event of current passing through the lightning arresters, they will be opened by the oil switch and immediately closed, which will usually have the effect of discontinuing any possible arcing and will avoid frequent shut-downs, which occur by the short-circuiting of light-

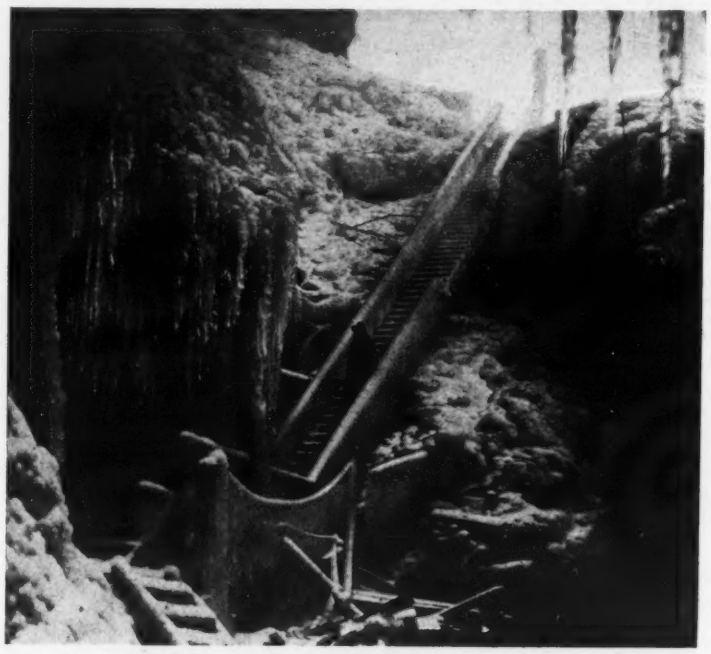


FIG. 11.—ICE FORMATION AT MOUTH OF TAIL RACE.

ning arresters. A very sensitive center zero reading voltmeter with adjustable resistance in its circuit will be used for watching and holding constant the voltage of the plant.

The face of the switchboard will carry upon it between the instruments a diagram of the connections, the voltmeter being used to represent the generator. Breaks are made in the red line diagram which is thus painted upon the instrument board, and these are backed by red incandescent lamps, the lighting of which will make the appearance of a continuous line through the otherwise open break in the line or bus-bars.

For the use of the officers and employees of the company a two-story building, known as the men's barracks, will be erected near the power house, the main dimensions of which will be 68 ft. by 45 ft. The first floor of the building will provide for a library, a kitchen, a dark room and a chemical room. On the second floor there will be rooms for the president, the superintendent and the housekeeper and seven bed chambers, besides the usual conveniences in way of baths and toilets. There will also be a large attic, which can be utilized for sleeping purposes in cases of emergency.

The White River generating plant will deliver its power into the same transmission system, which is supplied by the Snoqualmie Falls generating plant. This is a most elaborate and substantially constructed system, there being two independent pole lines and two circuits from each generating station, to the two terminals. The transmission is seven-strand aluminum cables, supported on "Imperial" porcelain insulators and the spacing of the wires in each circuit is 9 ft. in the triangle between centers. The aluminum conductors have given most marked satisfaction and the reliability of the service has proved itself unexcelled by any other plant in the country. The transmission is soon to be extended south in the direction of Portland, and north in the direction of Bellingham.

Mr. Baker and his associates have something like two million and a half dollars invested in the various enterprises which he has exploited, and the completion of the plans as they will progress from time to time with the development of the country upon the general scope laid down by Mr. Baker will aggregate an investment exceeding $8,000,000.

New German-American Cable.

The new cable steamship *Stephan* arrived at New York this week from Bremen, bringing 2,300 miles of Siemens cable (4,100 tons) to complete the New York-Fayal section of the German-American duplicate cable. After taking on coal and supplies here the *Stephan* will proceed to the buoy marking the end of the 100-mile stretch of the cable laid last autumn by another of the company's vessels. When the end of the cable is picked up it will be spliced and the *Stephan* will complete the connection with the Azores. The *Stephan* is commanded by Capt. Cornelius and carries a crew of 138 men. She was especially constructed for her present work and is provided with all the modern conveniences and improvements for laying cables. Her displacement is nearly three times that of the cable steamer *Von Pobielski*, her predecessor in the work, while her carrying capacity is nearly five times that of the older vessel. The *Stephan's* capacity is 5,000 tons.

The present German cable by way of the Azores was laid in 1900. It runs from Emden, Germany, to Fayal, and thence to the company's station on Coney Island, just east of the Oriental Hotel. It was determined last year to lay a duplicate cable over the same route. The section from Emden to Fayal has been completed. Only 100 of the 2,400 miles from Coney Island to Fayal has been covered at this end. The system is closely allied with that of the Commercial Cable Company controlled by the Mackays, and Mr. G. G. Ward has given special personal attention to the development of it.

Poolroom Wires.

A sharp and vigorous attack was made last week by the City Club of New York upon the Western Union Telegraph Company for its practice of supplying poolrooms—or race betting resorts forbidden by law—with telegraph service. The club asserts that if the company did not lease its wires to the pool rooms they would have to close their doors. The company asserts that its business requires it to give service to all and sundry without discrimination; at least this appears to be the attitude of the officials and the administration. Some of the newspapers have put in "caps" the names of the directors and have inquired what they mean by it and what they are going to do about it. The rate is said to be $30 per day, and $10 for the operator, and the company, or one of its officers, guarantees "a man who has a large experience, who knows the ropes and knows enough to climb out of the window when trouble comes."

Electricity at the St. Louis Exposition, 1904.

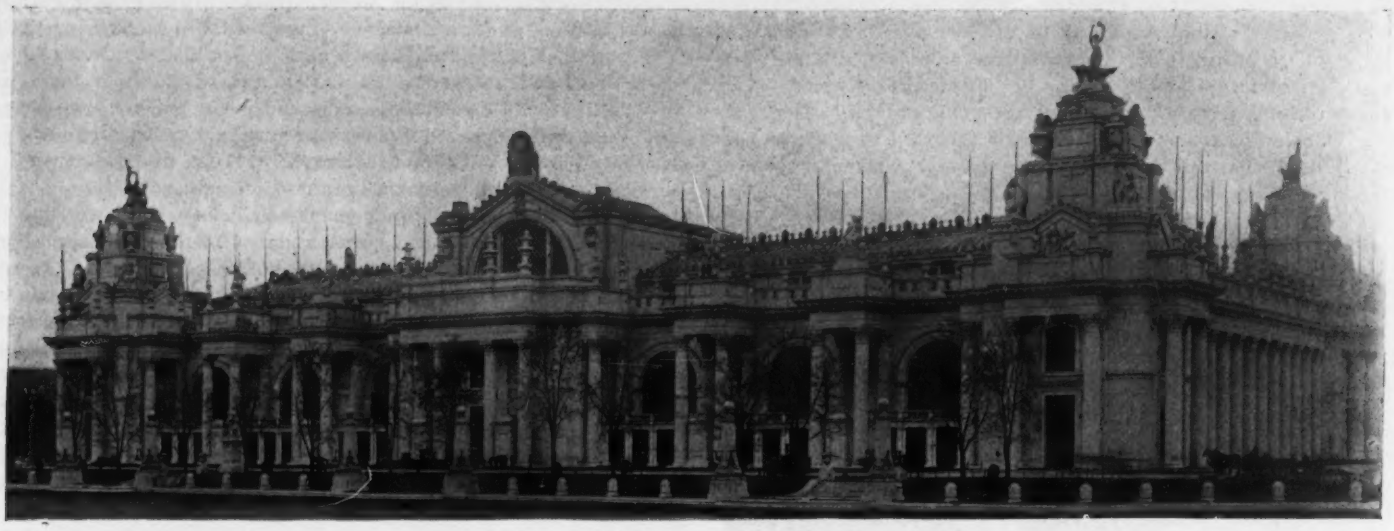


FIG. 1.—ELECTRICITY BUILDING.

THE St. Louis Exposition celebrating the purchase of the Louisiana Territory from the Emperor Napoleon by the United States was opened with great ceremony and rejoicing on April 30. Over a hundred thousand people were present on the grounds and elaborate ceremonies marked the occasion, while President Roosevelt, in Washington, in the presence of a large gathering, closed the electrical circuit which released and set the machinery in motion. Our columns have already contained a large number of illustrated and descriptive articles as to this latest and largest World's Fair and we now supplement them by a series of four special articles of a most interesting character with regard to the status of the Exposition at the moment of opening. As will be seen, these articles deal in a general way with the Exposition, outlining its features and comparing it with its predecessors, not only with respect to the application of electricity but also in respect to other details. As usual, the Exposition is not quite ready. One or two of the views which we present are sufficient to demonstrate this fact. No exposition ever was ready when its doors were thrown open to the public and probably none ever will be. There is every indication, however, that when it is at last in full running order the St. Louis Exposition will compare favorably with those which have gone before, particularly in regard to its technical and engineering features. We present herewith also a list of the exhibitors in Electricity Building, although the lists for the various foreign countries are not yet complete. It will be understood that a great many of the electrical exhibitors are also to be found in Machinery Building.

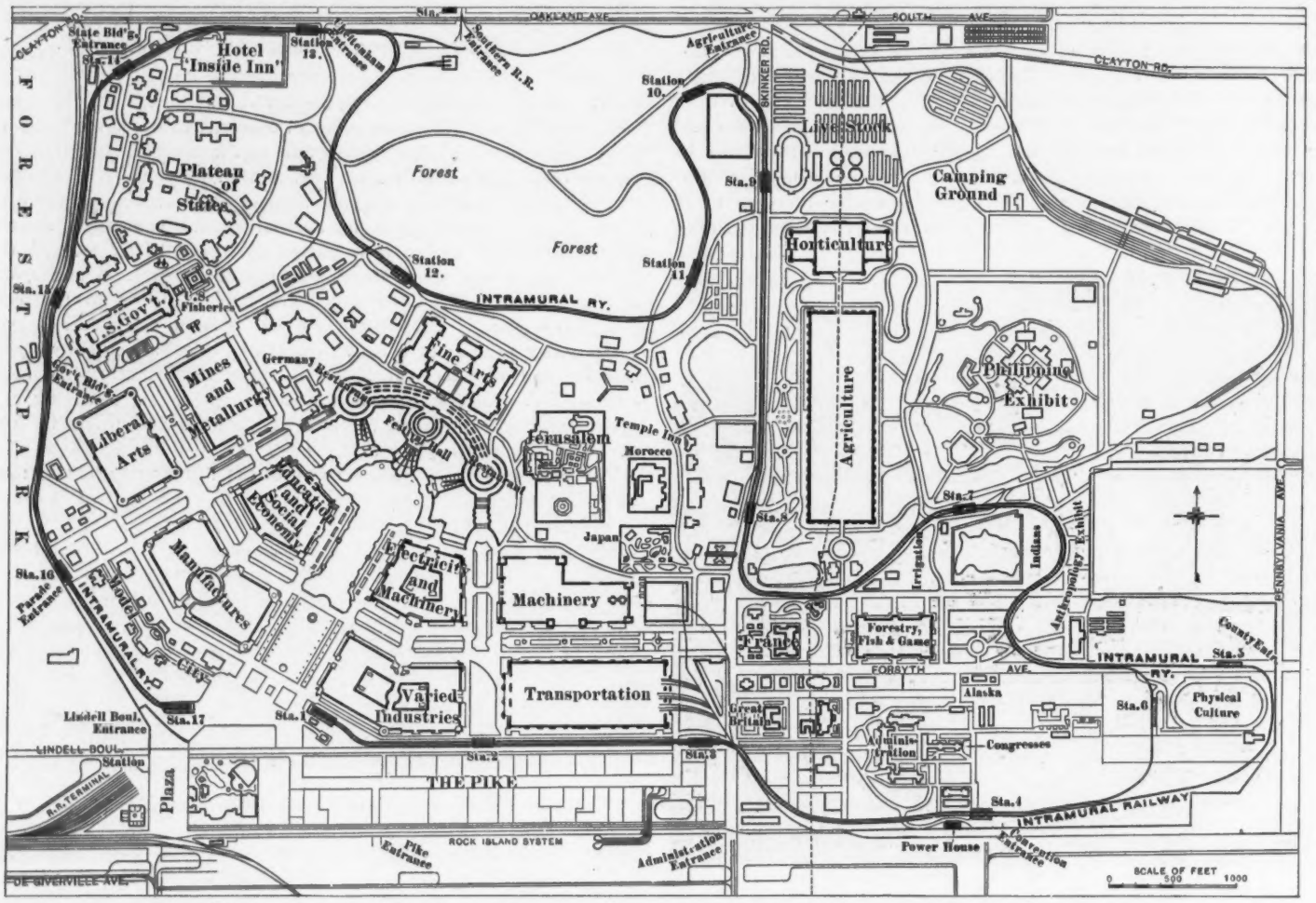


FIG. 2.—PLAN OF EXPOSITION GROUNDS, SHOWING INTRAMURAL ELECTRIC RAILWAY LINE.

Electricity at the Paris and St. Louis Expositions.

BY FRANZ WELZ.

THE great international expositions give a splendid opportunity to follow the development of every special branch of human activity. The last one was that held at Paris in 1900. In the time which has elapsed between that and the International Exposition in St. Louis in 1904 much progress has been made along some lines, especially electricity. It must be remembered that, even the Paris Exposition, which was in many respects the most complete representation of the civilization of the whole world, could not give an entire picture of the development in every line of human activity. As to electricity, only Germany, France, Belgium and Switzerland really showed fully what they were able to do in this line; whereas, the electrical industry of the United States and Great Britain was not sufficiently represented to give a proper conception of their standing in this special branch. England was handicapped by the South African war; in the case of the United States, the great distance between the two countries, in addition to the loss of the *Pauillac*, was the principal reason of inadequate display. At the St. Louis Exposition, as to the European countries, the long distance and the high cost of transportation has excluded all the heavy pieces of machinery and apparatus. The Russian-Japanese war and the depression in the commerce of Europe explain fully why the European exhibits in the Electricity Building at the World's Fair at St. Louis, do not give a full idea of the standing and the possibilities of the electrical industry in the countries on the other side of the ocean. On the other hand, it is noticeable that progressive Japan and the South American countries are participating to a larger degree in the electrical display at the St. Louis Exposition than they did in Paris. Whereas, Japan exhibited in Paris only some drawings, etc., concerning the governmental telegraph system, this country occupies at St. Louis a space of twelve hundred square feet in which several Japanese firms exhibit dynamos, motors, chandeliers, electroliers, telegraphic instruments, measuring instruments, instruments for electromedical use, etc., which are all designed by Japanese engineers and manufactured in that country. How far Japan has advanced in the electrical industry is shown by the fact that it is also exhibiting a high-tension transformer for 150,000 volts for testing purposes.

The St. Louis Exposition impresses the visitor especially by its magnitude. While the Paris Exposition occupied altogether an area of only five hundred and twenty-five acres, the World's Fair at St. Louis is extended over 1,240 acres; that is, two and one-half times the area of the Exposition at Paris. The total cost of the Paris Exposition has been calculated at $21,500,000. As to the St. Louis Exposition, no definite figures are yet available, but it is estimated that the total expense will amount to nearly $50,000,000.

A special feature of the St. Louis Exposition is the magnitude of the power station, generating current for the decorative illumination of the buildings and also the electric light and power for commercial use of the exhibitors. A summation of the output of the machines installed in the Machinery Hall, with the added energy furnished by the Union Electric Light & Power Company, of St. Louis, results in a total of 46,000 hp for this purpose. At Paris the total amount available for light and power purposes was 20,000 hp, of which 7,000 hp was generally used in day time and the full amount of 20,000 hp only on special days for illumination purposes.

The incandescent lamp is used to a very large extent at St. Louis for decorative lighting of the buildings, the Cascades, the main feature of the Fair, the bridges and lagoons surrounding these buildings. The architectural lines of each building are brought out into bold relief by thousands of 8-cp incandescent lamps, and 250,000 of these lamps are altogether used for this purpose, not including the energy used for the illumination of the Cascades, which amounts to 2,100 kw. Compared with these figures, the electric lighting display at the Paris Exposition does not make a very great show. With the exception of the "Chateau d'Eau," where about 1,200 hp was utilized for lighting effects, the statue of "L'Electricité" and the statue of "La Parisienne," very few incandescent lamps were used for decorative illumination at Paris; and outside the energy for commercial use, most of the current was employed for arc lighting in the streets of the Exposition. The total number of incandescent lamps used for decorative illumination at Paris was 76,720.

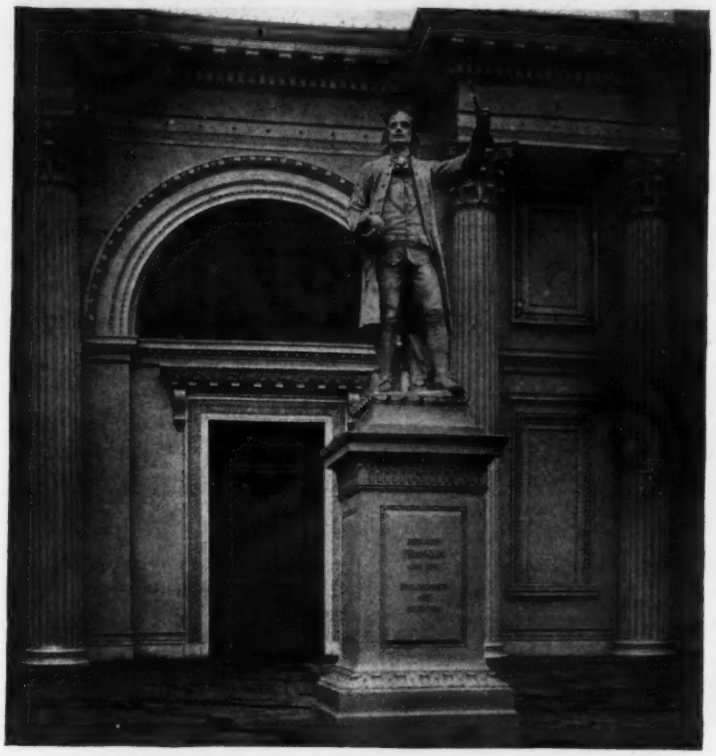


FIG. 3.—STATUE OF FRANKLIN IN FRONT OF ELECTRICITY BUILDING.

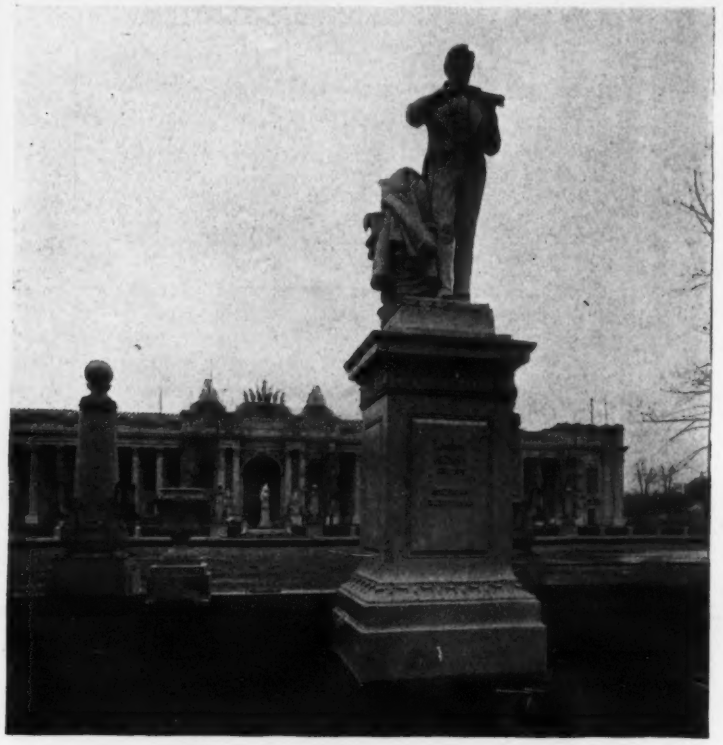


FIG. 4.—STATUE OF JOSEPH HENRY.

As to the means of transportation on the Exposition Grounds, St. Louis shows some new features compared with Paris. Besides the Intramural Railway, common to most of the Expositions, there will be an extensive use of electric automobiles and the electric push chair.

In regard to the electrical exhibits themselves, St. Louis also brings forth several new ideas. In most of the former expositions, the exhibits consisted of finished machinery and apparatus which were merely brought before the public as "dead" exhibits (not in operation), but at St. Louis it is the endeavor to show to the public the methods of the manufacture and this way of exhibiting is always far more instructive and attractive. There will be in St. Louis quite a number of these working exhibits. One of the most striking of these is an incandescent lamp factory in full operation.

In comparing the Exposition of 1889 at Paris with the 1900 Paris Exposition, the most striking fact was the increase in size of direct-current and alternating-current machines. It was the aim of the

large European electrical concerns to have the largest electrical machines possible at the 1900 Exposition. But since 1900 the size of the alternators shown at Paris has been increased nearly three times, and the engineering world has become so much accustomed to large units, this phase of the development does not constitute any longer a feature for an exposition. The alternators generating the power at the Exposition in St. Louis are not of exceptionally large capacity, and the only new features in this respect are the large steam turbines and gas engines, both of which have increased considerably in size since the Paris Exposition. These two prime-movers are entering more and more into the field of machines for generating power. Different systems of both these types will be seen at St. Louis and there will be ample opportunity to study their advantages and mechanism. In the construction of alternating-current dynamos the tendency prevailed to produce as near as possible sine waves, and many

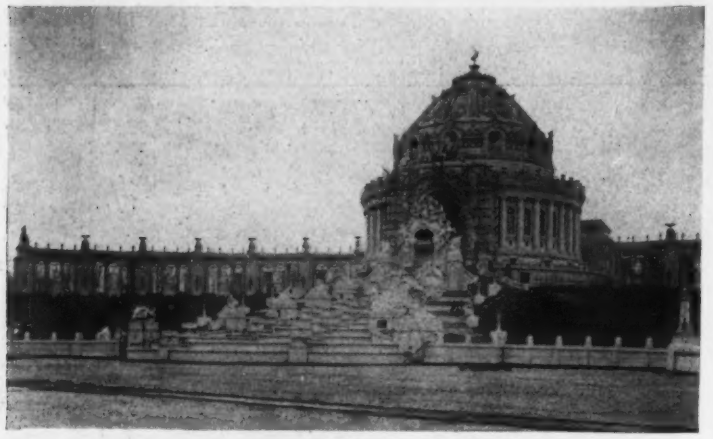


FIG. 5.—CASCADES—THE ELECTRIC FOUNTAIN.

new devices have been proposed and accomplished in this direction since the Paris Exposition. Another remarkable change in the construction of electrical machinery since the Paris Exposition is in the decrease of weight and price of electrical dynamos and motors sustaining at the same time the same quality and durability. This fact is illustrated in a very striking manner by the two sets of curves shown taken from the data of one of the most successful German electrical firms. These curves are laid out in such a way that two of them give the number of kilograms used per kilowatt, whereas the others give the cost in marks (4.2 marks equal $1.00) per kilowatt. In order to make the comparison correct, the kilowatts are reduced to thousand revolutions. These curves show that, compared

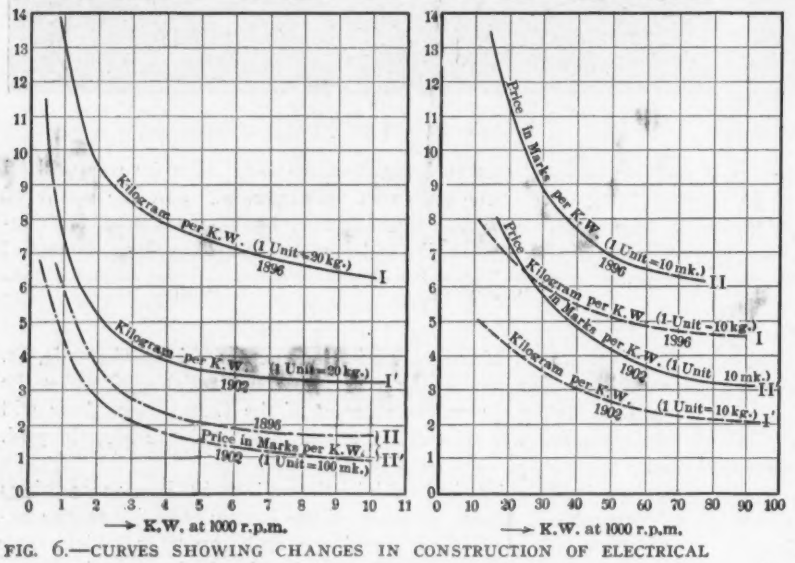


FIG. 6.—CURVES SHOWING CHANGES IN CONSTRUCTION OF ELECTRICAL MACHINERY.

with the year 1896, the same output of kilowatts is now obtained with only half the material used at that time.

As to direct-current dynamos, we see some improvements since 1900, inasmuch as the armature reaction and the distortion of the magnetic field have been remedied by the compensation winding of Déri and others, and a very important use has been made of this new feature in employing electric machinery for hoisting in mines, where it is necessary to regulate, under the full current, the voltage in the shunt from full voltage down to zero, and then reverse. This gives new possibilities for the employment of electricity in mines, etc. The greatest progress which has been made since the Paris Exposition, and to which the Exposition at St. Louis will bear eloquent testimony, lies in the single-phase field. The cause for this advance was the increasing demand for a practicable electric system for long-distance electric railways. The variable-speed, single-phase motor was the long-looked-for solution of this vital problem. It is gratifying to state that several types of this motor have been devised recently both on this side of the ocean and in Europe. At St. Louis

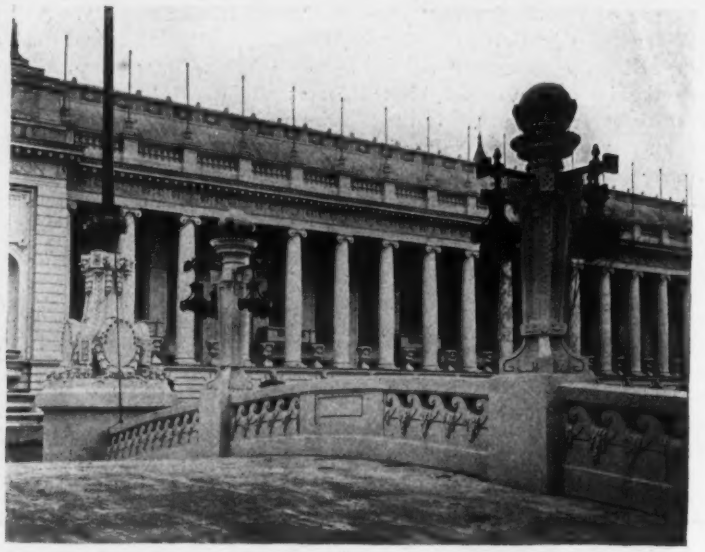


FIG. 7.—BRIDGE, SHOWING ILLUMINATION LAMPS USED ON GROUNDS.

there will be ample opportunity to see these new motors in operation and engineers will have a chance to convince themselves as to their fitness for the railway service. The experience gained by the trials at the Berlin-Zossen high-speed electric railway seems to indicate that the system best adapted for this purpose is that which allows the direct application of high voltage to the motors. This system decreases the weight of the car, as no transformers have to be carried; it has the added advantage of making the erection of transformer sub-stations unnecessary at different points of the line, the whole line being under high tension. These considerations led at the Berlin-Zossen trials to the construction of 10,000-volt, three-phase motors, which were tested on this line in the beginning of 1902, and gave entirely satisfactory results. Another new step in the alternating-current field which will be demonstrated at St. Louis, and which will probably prove to be of far-reaching importance, is the compensating of alternators worked out by Mr. Heyland, and his still more promising latest invention: the compounding of synchronous machines. The results obtained with these machines were so favorable that several European firms and also one of the American electrical manufacturers have taken up the construction of these new types, which are now being built up to a capacity of 1,500 kw.

Quite a new departure in central station development promises to become the commercial application of the Cooper Hewitt converter. The reports which so far have been obtainable show such remarkable advantages as to efficiency and size, that, if these reports hold practicable, it would mean a revolution in a large part of the electrical industry. It is understood that the company exploiting these patents will give at the St. Louis Exposition full proof of the promised qualities of this new apparatus.

Other forms of converter which aroused new interest lately are the Noden and Grisson-Walter electrolytic types, which seem to have an efficiency of 75 per cent. The rotary converter, which was exhibited at the Paris Exposition, only to a very small extent, will be a large feature at the coming fair, and European engineers less familiar with this type of machine will have opportunities of getting convinced of the excellent qualities of these machines and their feasibility for sub-station work. As is well known, the European practice tends more to the motor-generator, and the general opinion there is that it is in many respects superior to the rotary converter.

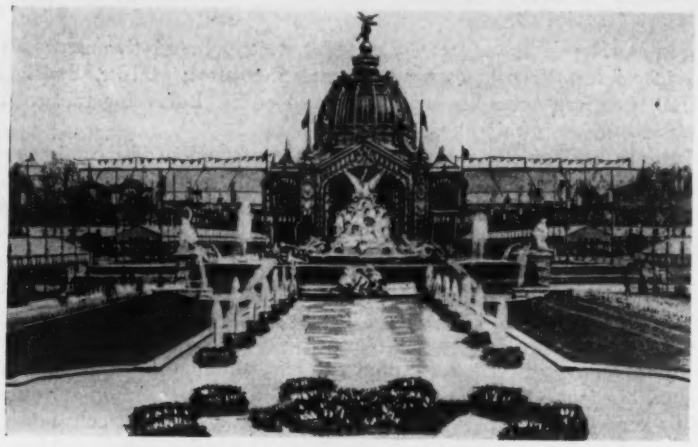


FIG. 8.—MONUMENTAL FOUNTAIN, PARIS EXPOSITION, 1889.

FIG. 9.—INTERIOR ELECTRICITY BUILDING, CHICAGO, 1893.

FIG. 10.—VIEW OF DECORATIVE LIGHTING, BUFFALO PAN-AMERICAN, 1902.

FIG. 11.—ELECTRICITY BUILDING, CHICAGO, 1893.

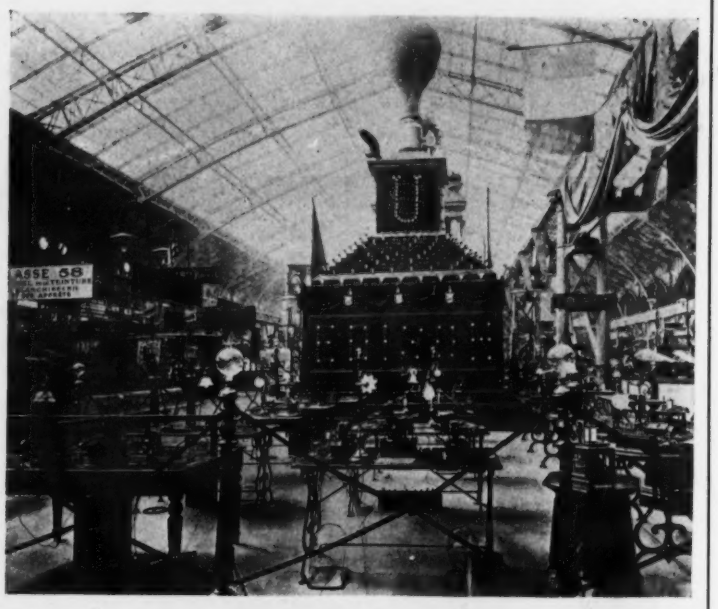


FIG. 12.—VIEW OF ELECTRICAL EXHIBITS, PARIS EXPOSITION, 1889.

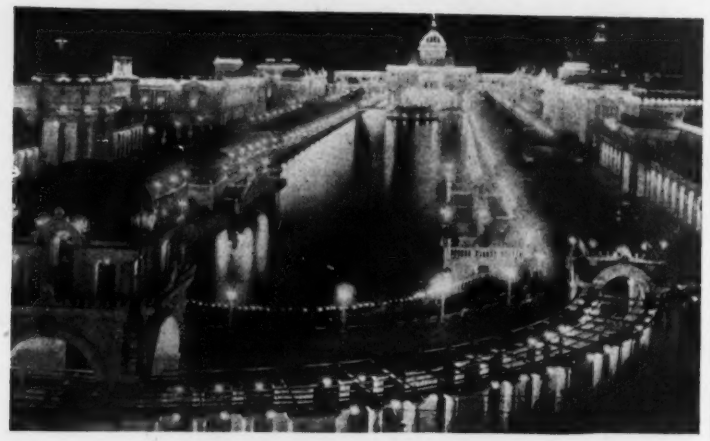


FIG. 13.—DECORATIVE LIGHTING, COURT OF HONOR, OMAHA, 1898.

FIG. 14.—PALACE OF ELECTRICITY AND FOUNTAIN, PARIS, 1900.

EXAMPLES OF BUILDINGS, LIGHTING EFFECTS, ETC., AT FORMER EXPOSITIONS.

A very interesting and novel exhibit in the line of electric machinery will be a model testing floor in the Bullock space, which will be equipped with the most modern instruments, and will give a fair idea of the excellent equipment of American electrical factories.

Some additional new features will be seen at the St. Louis Exposition concerning the development of the electric railway since the Paris Exposition. These are largely along the line of high-speed and will be represented at St. Louis by models and drawings, such as the mono-railway "Behr" system, for 110 miles per hour, the suspended electric railway system of Langen employed in Elberfeld, the high-speed electric railway system employed at Berlin-Zossen, and several other suspended electric railway methods. The question at present is as to whether or not such high speeds as 125 miles per hour are practical; and, as soon as this question is fully decided, the superiority of either one of these systems must be proved. According to recent reports, the Langen system affords the possibility of speeds up to 200 miles per hour with perfect safety, disregarding other advantages.

At the Paris Exposition there was manifested a marked tendency for creating uniform types of electrical machinery and apparatus, all over the world. Since that time this tendency has taken more practical form, and the proposition has been made to treat this question elaborately at the Electrical Congress during the St. Louis Exposition. This proposition tends to establish standard rules for measuring and testing electrical machinery, and it is to be hoped that this end can be reached, as it would simplify to a very great extent the commercial and scientific negotiations between different nations, and greatly help the advancement of the science and industry.

In the field of electrochemistry the Edison iron-nickel storage battery will make its appearance at the Exposition. The methods of storing electricity are not as yet of very high efficiency, and it would mean a very great advance if an accumulator could be built which, with small weight and great durability would permit the storing and quick discharge of a considerable amount of electricity. Whether or not the Edison accumulator possesses these qualities to the extent that has been reported will be proven by the results obtained from the exhibit at St. Louis, and definite facts will doubtless replace the hypothetical opinions concerning this battery. In comparing the electrochemical display in St. Louis with Paris, it may be remembered that at the Paris Exposition electrochemistry formed for the first time a special group, and many of the electrochemical processes were only shown in their very first beginnings. At St. Louis will be exhibited many of these processes, such as electrical water purifying, electroengraving, electrical gold extraction, etc., that have been developed to a great state of perfection, and the names of Goldschmidt, Nernst, Ostwald, Drude, Siemens & Halske, Bradley, Hall, Cowles, Acheson, etc., will stand at St. Louis for the great advance made in this line.

In the field of electric illumination, the perfection of incandescent lighting and similar systems has not yet been reached to the full extent. Progress has not been as rapid as was hoped, but still it must be said that the Nernst lamp has been improved greatly since Paris. This lamp appeared publicly for the first time at Paris, being there lighted primarily with a match, and showing very many imperfections, so that it could be only employed to a small extent even as an exhibit. As the Nernst lamp stands to-day, it is already holding a very important place between the incandescent lamp and the arc lamp as a pure, brilliant illuminant. The state of practical perfection at which this lamp has arrived is best illustrated by the fact that it does not by any means figure at St. Louis merely as an exhibit, but is employed commercially for numerous electrical installations; while there will be used altogether more than 12,000 Nernst lamp glowers in buildings and exhibit pavilions on the World's Fair grounds. It is much to be regretted that the invention of Auer, the "osmium lamp" has not yet proved to be a full success, and hence the St. Louis Exposition will be deprived of the opportunity to show this lamp. Instead of this, however, the Cooper Hewitt mercury lamp will be brought for the first time before the eyes of the public, in a large way in its various applications for lighting and other purposes. There is no doubt that this strange, brilliant illuminant will attract the attention, not only of the great public, but also of the artisan and engineer.

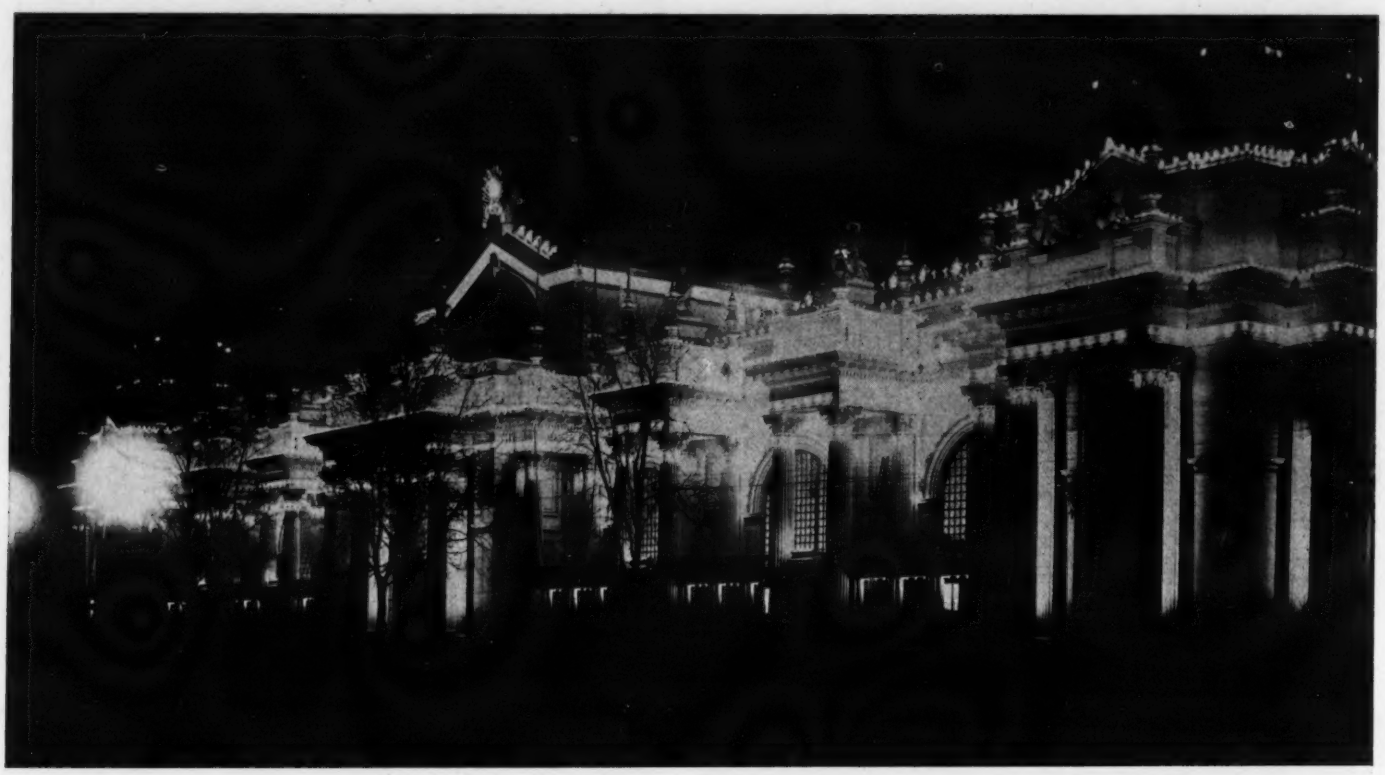


Fig. 15.—Night View of Electricity Building, St. Louis.

A very attractive novelty in decorative lighting with incandescent lamps will be demonstrated in the so-called "pearl system," an invention of Mr. G. Weismann, of Paris. This adapts itself very nicely to all kinds of electroliers and specialties for garlands. The circuit is formed by bare wires, each one surrounded by small pearls creating a very effective insulation. In connecting the lamps it is only necessary to introduce between two pearls a wire attached to the main wire by a hook, the two wires leading to the incandescent lamp also being insulated by small pearls. The lamp does not possess any socket, and the wires enter the bulb directly.

As to are lamps, some progress has been made in bringing out small types of high reliability. The greatest difficulty is that this system does not possess the same simplicity in operation and construction as the incandescent lamp. Considerable improvement has been made in these respects and the inventions of the Italian engineer, Rignon, and others, will prove the fact at St. Louis. The Bremer arc lamp was shown for the first time at the Paris Exposi-

tion, as at that time one of the latest inventions in the art of electric lighting. Since then many improvements have been made in it and the lamp has found large application all over Europe. The Westinghouse Company has acquired the patents and will show this new type of lamp at the St. Louis Exposition in its latest state of perfection. It may be remembered that, in these lamps, carbons of special preparation are used for the purpose of increasing very considerably the amount of light per watt. This special treatment of the carbons has the added effect of softening the light and making it more agreeable to the eye. Other types of lamps of foreign construction will be exhibited by Siemens & Halske, etc., and M. Blondel, of Paris, who will show his new type of flame arc lamps.

An interesting feature at the St. Louis Exposition for the European electrical engineers will be the largely represented series alternating arc systems, as worked out by the General Electric Company, the Western Electric Company, the Fort Wayne Electric Works, and others. This system is very seldom employed in Europe, where for arc lighting installations on a large scale the shunt system is mostly used.

Nothing of especial importance has been invented in the way of distribution; but it might be mentioned that, since the Paris Exposition, the 220-volt incandescent lamp has come into more extensive use and has attained a very high efficiency. The improvement of this type of lamp has developed the more extensive erection of central stations of 220-volt voltage, and the use of a three-wire system of 440 volts between the outside wires and 220 between the outside and neutral. To the list of lightning arresters, a valuable addition has been made in the Siemens & Halske so-called "Hoernerblitzableiter." Another new invention in this direction is that of the Italian engineer, Fala, who will show at the St. Louis Exposition his new lightning arresters in series, with which very good results have been obtained in the large Italian high-tension central stations.

Telephony and telegraphy will make a very creditable showing at the 1904 Exposition. The great advance in these branches is largely due to the liberal patronage accorded them in the United States. The American Telephone & Telegraph Company, of Boston, will demonstrate in a special building with a very artistic exterior the development of the inventions of Prof. Bell and others from the very beginning up to the present time; and several other "independent" American companies are exhibiting their latest and best types of apparatus, including automatic telephone systems, in which class the Faller takes a very prominent place. At the time of the Paris Exposition, these automatic systems had not reached a very high grade of perfection, but at the present time the solution of this problem becomes more and more imperative, and such systems are being worked out in great numbers, and of notable ingenuity.

One of the prominent places in the Electricity Building and the Exposition at St. Louis as a whole, will be occupied by the wireless

FIG. 16.—VARIED INDUSTRIES BUILDING AT NIGHT.

telegraph stations of the American De Forest Wireless Telegraph Company, of New York. At the time of the Paris Exposition the principles of wireless telegraph were known, and quite a number of apparatii were shown there. The De Forest wireless station at St. Louis is of considerable magnitude. In the Electricity Building three towers of seventy-five feet each in height have been erected, whence messages will be sent to the wireless telegraph station in the "Model City" of the World's Fair grounds. Another mast of 200 ft. high with 50-ft. outriggers, is put up near the site of "Jerusalem," and a steel tower of 325 ft. near the Press Building. From these stations it is expected to send messages to the neighboring cities. In addition to the De Forest Company, the wireless transmission of electrical waves has been exploited by many inventors and firms, since 1900, and wireless apparatus for different purposes are shown at St. Louis by the French engineer, M. E. Ducretet, by T. E. Clark, of Detroit, and the Italian, Professor A. Artom. Besides wireless telegraphy, a new feature will be the demonstration of wireless telephony by A. F. Collins and M. R. Hutchison. It may be remembered that at the time of the Paris Exposition none of these systems were in use, thus giving St. Louis the distinction of showing them as part of the practical art for the first time. It is to be regretted that in addition to these systems the German inventor, Ernst Ruhmer, has

FIG. 17.—LOOKING TOWARD ELECTRICITY BUILDING.

not been able to bring to this country his apparatus for wireless telephony, based upon the action of light rays upon the selenium cells. This inventor has succeeded in talking over a distance of about six miles and has also succeeded in effecting long-distance telephonic communication between ships.

In the section of various applications of electricity there are also some new departures comparing St. Louis with Paris. The great number and variety of electrotherapeutic apparatus is striking and gives the best proof of the high value of electricity for special medical examinations and treatment of certain cancerous diseases. For the first time it will be shown publicly at the St. Louis Exposition how the ultra-violet rays of the arc lamps, the chemical rays, can be used successfully for the cure of the most obstinate cases of "lupus vulgaris" and similar diseases. The Danish physician, Prof. Niels R. Finsen, must be credited with having introduced this new method for the first time, and its application is quickly spreading all over the world. France, in which country the radium was discovered and thoroughly studied, has the honor of exhibiting for the first time in St. Louis the different apparatus for the investigation of this wonderful element, of which apparatus the "Spinthariscope," showing the scintillations of the radium, is the most interesting. Another new application of electricity in the medical field is the "Acousticon" and the "Massacon" inventions of Mr. M. R. Hutchison, which aroused so much admiration all over the world. These apparatii make it possible to teach the deaf mutes to hear and to speak.

In the line of electrical instruction the St. Louis Exposition can also show a typical American novelty, nearly unknown to the European practice; that is, "the American School of Correspondence." The exhibit of this institution will give full testimony of the success which has been attained by this unique method of teaching, speaking for its excellency and the ability of the promoters. It must be admitted that for a certain class of students and under the peculiar conditions of such a large country as the United States, this method of teaching certainly has its right of existence.

When the most prominent electrical engineers of the world assemble in St. Louis during September, for the International Electrical Congress, they will look with pride upon the brilliant electrical display; and in viewing the exhibits in the Electricity Palace, they will be impressed with their highly technical value, and the imposing and systematic arrangement. The whole will be a full and worthy demonstration of the progress made in electrical science and industry since the Paris Exposition of 1900.

The Installation of Exhibits in the Electricity Building, St. Louis.

By Cloyd Marshall.

THE construction of booths and the installation of exhibits are proceeding rapidly in the Palace of Electricity and on the opening day, April 30, this building was ready for the reception of visitors. To get all the exhibitors to ship machinery and begin construction in time for completion, before the gates open, is one of the difficult problems of every exposition. At St. Louis the department buildings have been constructed for some time and the Palace of Electricity has been under cover for ten months. Every effort has been made to impress upon the exhibitors the advantage of coming early to avoid the rush of the last one or two weeks before the opening. The Electrical Department has met with ready response and co-operation from the electrical manufacturers.

By reference to the installation plan of the Electricity Building the outline of exhibits may be followed. In the gallery over Sections 1 and 2 are the offices of the department, jury and committee rooms. With this exception there is no second floor to any part of the building, all exhibits being on the ground floor with ample head room. The cone of the roof is about 75 ft. above the floor, with skylights and monitors which give abundant light and ventilation. In Section 1 facing Aisle B are the offices of the Electrical World and Engineer. Telegraph exhibits and the main Exposition offices of the Postal and Western Union Telegraph offices occupy the same locality. High-speed telegraph systems are to be shown in operation by Patrick B. Delany and Walter P. Phillips, while Charles E. Yetman will exhibit a transmitting typewriter applied to telegraphic work. The Gray telautograph, or writing telegraph, reproducing at a distance writing and drawings, will be in operation.

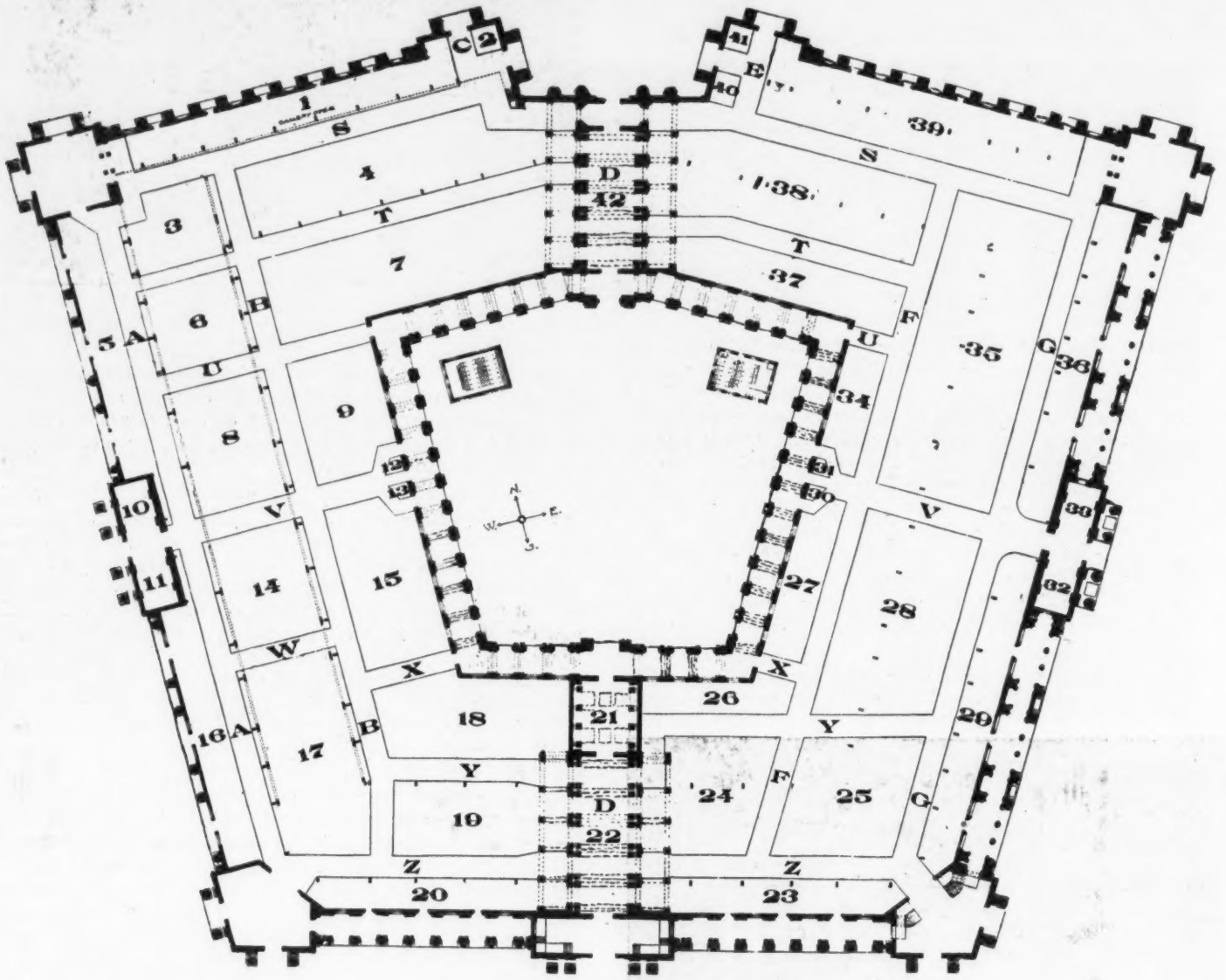


Fig. 18.—Plan of Electricity Building.

Near the center of Section 4 is located the sub-station which contains transformers, switchboards and rotary converters through which the high-potential alternating current is received from the service power plant and transformed to a lower voltage or converted to a direct current for distribution throughout the building, to be used for lighting and the operation of exhibits. This machinery was furnished chiefly by the General Electric and Westinghouse Electric & Manufacturing Companies. Adjoining the station the latter company is installing one of the largest exhibits in the building, embracing the varied branches of electrical machinery and apparatus. Across Aisle B will be the electric railway trucks and locomotives of Burnham, Williams & Co. Along the north side of Section 3 the Standard Underground Cable Company and the McRoy Conduit Company are installing a model conduit system, as used in the best city construction, and will show the method of placing cables in the conduits. A very conspicuous object is to be a Burdette-Rowntree electric dumb waiter running from the floor to the roof above Section 3. Its operation is automatic, starting or stopping in response to a push button.

Over Sections 3 to 17, along the west side of the building, is the craneway with a span of 57 ft. 5½ in. Upon this is a four-motor, 30-ton electric traveling crane furnished by Pawling & Harnischfeger. A 20-hp, 220-volt motor gives a horizontal speed of 250 ft. per minute, and an 8-hp motor gives a trolley transverse speed of 150 ft. The main hoist is equipped with a 30-hp motor with a speed of 25 ft., and the auxiliary hoist with a 15-hp motor, and has a travel from 30 to 90 ft. per minute. The crane has proved very serviceable in the installation of exhibits and will be used in handling heavy machinery when exhibits are dismantled. With one exception the heavy exhibits are to be installed under or adjoining the craneway.

In the northwest corner are several displays of electric railway equipment. The electric and air brake apparatus of the National

Electric Company is shown as well as a line of alternating and direct-current generators and motors. Block 9 is equally divided between the Fort Wayne Electric Works and the Wagner Electric Manufacturing Company, both putting in working exhibits. The Fort Wayne display consists of a line of direct-current machinery, transformers, fan motors, wattmeters and a series arc light system. The Wagner space contains a variety of single-phase alternating-current power motors running under different conditions, motor-generator sets charging a storage battery, static transformers and indicating switchboard instruments.

The remaining space adjoining the court is occupied by the Bullock Electric Company and it is one of the notable machinery exhibits. A 6,600-volt alternating current is received and transformed to 340 volts for a rotary converter to supply 500-volt direct current for operating street railway apparatus. Other motor-generators and balancing sets furnish current for multivoltage systems as applied to speed control for machine tools. The individual feature of this exhibit is a model testing floor, indicating the best methods of testing electrical machinery before it goes to the customer. Under the traveling crane the Northern Electrical Manufacturing Company will have the most complete demonstration of the adaptation of electric motors to every form of tool. In this exhibit the manufacturing of motors is to be carried out in a way to show the convenience and increased efficiency of motor-driven tools. All of Block 17 under the craneway is taken by the Western Electric Company. Near the center is a large 100-kw motor-generator set which, with a compensator, furnishes 110 and 220-volt direct current throughout the exhibit. Next Aisle B is a small machine shop in operation, showing the direct application of motors to tools. There are to be several direct-connected marine sets, transformers and regulating apparatus. On the opposite side is to be a series alternating arc light equipment with ornamental lamps and stands.

There are two collective exhibits, embracing nearly all electrical classifications, one by the Wesco Supply Company, of St. Louis, in Block 8, and another by Ewing-Merkle covering a portion of Block 14. In the former a large Warren synchronous motor drives a Triumph generator supplying power for the motors and apparatus in operation. In the second exhibit the Commercial Electric Company will have a number of direct-current motors from 1¼ to 35 hp, a 30-kw, three-bearing generator direct-connected to a gas engine, furnish power for the other exhibit items. A special feature is a line of variable-speed motors designed for operating on any standard two-wire system, with single voltage, and which will give speed variations of from 4 to 1, with horse-power and efficiency practically constant at all speeds, and little if any variation of speed at all loads with the controller set at a given point.

The western entrance embraces two large spaces, which are occupied by unique exhibits. The Carman Projector & Specialty Company will show stereopticons, lanterns, projectors and automatic electric curtain hoists in operation. Opposite is the electroplating exhibit of the Hall Gold & Silver Plating Works. The different processes of plating and finishing of plated wares are to be shown in a most attractive manner. The Gould Storage Battery Company and the Gould Coupler Company are installing a fine combination exhibit in Section 16, which includes motor-generator sets and rotary transformers to charge storage batteries, to be arranged so that many ingenious applications of batteries to different lines of work will be illustrated. An interesting item is a motor-driven unipolar dynamo, charging two immense cells at from 3,000 to 5,000 amp. at about 5 volts. In the northern half of Block 16 is being placed the artistic exhibit of Japan. This electrical apparatus was designed and made by Japanese, most of whom received their education and training in this country. The Italian space, occupying Block 18, is especially worthy of notice on account of the scientific and electrical measuring instruments therein. A model central station storage battery plant in a fire and acid-proof enclosure is now being placed by the Electric Storage Battery Company. A conspicuous feature is an immense map of the United States showing the location of between 1,600 and 1,700 plants installed by this company, the railway, lighting, telephone and isolated installations being indicated by different colored

FIG. 19.—ENTRANCE TO ELECTRICITY BUILDING.

lamps. The Porter Battery Company will have a battery on exhibition which has been in constant service over eight years, and another which made a record automobile run of 187 miles on one charge.

The three 75-ft. towers of the De Forest Wireless Telegraph Company are erected and will support the antenna from which wireless messages can be sent and received from other stations in the building and the large station in the model city. The T. E. Clark Wireless Telegraph-Telephone Company shows a line of wireless apparatus in operation, and the adaptation of such apparatus to fire alarms and safety signalling on railroads. Two wireless telephone stations at opposite ends of the building will be used by A. F. Collins to demonstrate the newest application of electricity to the transmission of intelligence. Two telephone operating exchanges are in the south side of the building, both enclosed by handsome booths. Section 17, not covered by the crane, is occupied by the exchange of the American Telephone & Telegraph Company. This connects with the local and long-distance lines of the Bell Company, so that there is direct communication from the building to all parts of the grounds, city and all points reached by telephone lines. In Section 24 the exchange of the Kellogg Switchboard & Supply Company gives a floor space. A great variety of electrical apparatus manufactured by this company is now being installed and will be shown in operation. The Edison exhibits are in Sections 26 and 27, and include the iron-nickel storage battery and a historical collection of great merit.

The purification of water by electricity is shown by the Standard Water Purifying Company, in Block 33, and water absolutely free from all forms of organic life will be served to visitors. Electrotherapeutic apparatus represents one of the most beneficial adaptations of electricity, and the latest developments in this line are shown in Section 4, by the representative manufacturers of such apparatus. In the northeast part of the building are the German and French collections of electrical exhibits; the former is especially strong in electrochemistry. France has the most comprehensive display of any foreign country, covering as it does every classification. In the eastern half of Block 7 England is making an excellent showing of its electrical products.

This outline of the exhibits being placed in the Electrical Building is of necessity incomplete at this time. Many companies now preparing displays have not proceeded far enough with their installations in the building that an account can be given of their displays.

FIG. 20.—A VIEW OF ELECTRICITY BUILDING BY NIGHT.

similar service through its connection with the Kinloch system, of St. Louis. Recent developments of automatic and semi-automatic telephone systems are to be shown in a thorough manner by the Automatic Electric and the Fuller Automatic Telephone Exchange Companies. An instructive historical collection of telephone apparatus is to be arranged by B. F. Wasson in Block 25.

In a fine booth erected by the Hutchison Acoustic Company will be exhibited the "Acousticon" and "Massacon," giving daily exhibitions of deaf mutes being made to hear and taught to speak through their instrumentality. M. R. Hutchison will also demonstrate a wonderful adaptation of the wireless telephone. Around the court of the Electricity Building is a circuit of wires connected to the booth in Block 23. Before a telephone transmitter in the booth, music will be played. In the court no sound of this is heard until a pocket telephone receiver, without any wire connection is placed to the ear and then the music becomes audible. At any point in the court music can be heard by the aid of the receiver.

Two beautiful booths in Section 25 are those of the Holophane Glass Company and the Weston Electric Instrument Company, the latter showing a full line of standardizing electrical instruments. The brilliant illumination of the Holophane exhibit will be most conspicuous, as 1,000 incandescent lamps cover the exterior and interior of their handsome structure. The laboratories of the National Bureau of Standards, covering a space of 23 by 200 ft., will contain over $50,000 worth of instruments for testing every kind of electrical machine and apparatus. About twenty government experts are connected with the laboratories to conduct tests and investigations. No preceding Exposition ever had such facilities for making complete records or assisting the juries in their awards.

The largest individual exhibit is that of the General Electric Company, embracing Section 28, and covering a quarter of an acre of However, it will be apparent by the foregoing that American manufacturers will far surpass any previous effort, and that the electrical exhibits at St. Louis will be a source of pride to all those interested in the industry. By the time this article appears most if not all of the exhibits will be in good shape, ready for inspection.

The "Pike" at St. Louis.

One of the most famous features at the World's Fair in Chicago, in 1893 was the Midway. It is safe to say that everybody went there, whatever else they did not see. In like manner the St. Louis Exposition has its happily named "Pike," and a more extraordinary or fascinating collection of side shows was never got together under the sun. It is estimated that $5,000,000 has been spent on the attractions, while the number of performers is put at 6,000. Forty or fifty dollars can easily be spent doing all the attractions properly. It is true that many of these shows have been seen at other Expositions, but they will probably be new to a majority of the visitors, and some of them are well worth a visit more than once. It is interesting to note that in nearly all of them, electric lights and motors are freely used; in fact some of the most novel and brilliant effects depend upon applications of electricity. An example of this will be found in the spectacle of the Galveston Flood; while in the thrilling pictures of "Fire Fighting," no actual fire is used, but the effects are obtained with electricity, steam, stained glass and electromechanical appliances. Such names as "Creation," "Hereafter," "Haunted Castle," "Submarine Diving" "Wireless Telegraphy," also suggest a variety of means by which electricity is to be brought into play to please or fascinate the multitude.

Electrical and Mechanical Engineering in the Exposition Plant.

By J. R. CRAVATH.

AT the Louisiana Purchase Exposition there will be of interest to engineers all the great electrical and mechanical exhibits coming under the Division of Exhibits and the application of mechanical and electrical engineering in the operation of the Exposition coming under the Division of Works. These two divisions overlap in so far as exhibit apparatus is used in the service of the Exposition. It is the purpose of the present article to summarize the work of the electrical and mechanical department of the Division of Works. The Division of Works builds and operates the Exposition, including the construction and operation of the necessary steam, electric and hydraulic machinery to properly serve the needs of the Exposition. This latter apparatus comes under the mechanical and electrical department of the Division of Works. All of the work in the Division of Works is in charge of Director Isaac S. Taylor. Mr. Henry Rustin was chief of the mechanical and electrical department until ill health compelled him to drop this work. His place was taken by Mr. E. B. Ellicott, city electrician of Chicago, who associated with him R. H. Moore, electrical engineer, and H. F. Smith, mechanical engineer.

SOURCES OF ENERGY.

Those having in charge the electric light and power service of the Exposition have had placed at their disposal three sources of energy: The Union Light & Power Company, of St. Louis, has agreed to deliver at the Exposition grounds, before the opening of the Exposition, 7,500 kw, in three-phase, 25-cycle, 6,600-volt current. In the Machinery Building the Exposition has a service plant of 8,000 kw, for which it contracted with the Westinghouse Electric & Manufacturing Company. This service plant was described in ELECTRICAL WORLD AND ENGINEER of January 23, 1903, and February 27, 1903. This plant also gives 25-cycle, 6,600-volt, three-phase current. In addition to this there will be in the Machinery Building exhibitors' apparatus, capable of supplying 8,000 kw in similar current for the service of the Exposition. The total amount of 6,600-volt, three-phase, 25-cycle current will, therefore, be about 23,500 kw. Besides this, exhibitors' apparatus is expected to furnish 2,400 kw in 550-volt direct current and 600 kw in 250-volt direct current. In the various buildings where necessary, rotary converters operated from the standard three-phase circuits of the Exposition are placed and will be used to supply 110-volt direct current for the use of exhibitors.

Both service and exhibit plants are to be supplied with steam from boilers in the Steam and Fuels Building. The distance that steam will have to be piped for some of the large units will be over 700 ft., and more than this for some of the smaller units. In the Steam and Fuels Building are sixteen 400-hp Babcock & Wilcox boilers equipped with Roney stokers.

The exhibit boiler plant will probably have 300 hp in Derr boilers, 550 hp in Clonbrock, 800 hp in Niclausse, 900 hp in Belleville, 3,200 hp in Heine, 7,200 hp in Cahall, and possibly 800 hp more. The rated boiler capacity for the entire building will, therefore, be about 19,350 hp. The Heine boilers will be equipped with Greene link grates, and the Cahall boilers with Aultman & Taylor chain grates.

The stacks for the boiler plant are all 90 ft. high and induced draft will be used throughout. The erection of buildings falls to the work of this division of the Exposition. Much of the work is being done by the Exposition company's own men, but steam piping contracts to the amount of $160,000 have been let in connection with the Exposition steam plant. The three concerns with which contracts have been made for steam piping are the Hanley Casey Company, Kroeschell Bros. and W. A. Pope. A detailed description of the Westinghouse service plant has already been given, as above mentioned.

CONDENSING PLANT.

Most of the large engines will be run condensing. The Westinghouse service plant is equipped with its own cooling towers. The exhibitors' service plant will take condensing water from the lagoons. An interesting engineering feature of the Exposition will be the fact that the Cascades, which is the name applied to the great artificial waterfall, which is to form the central feature of the Exposition panorama, will act, as at Paris, as a cooling tower for the condensing water used by the exhibitors' power plant. The condensers in the Machinery Building will discharge hot water into a tunnel, which runs 1,100 ft. from the Machinery Building to the suction of the Cascade pumps. Much of this tunnel is under the lagoon. From the Machinery Building to the lagoon a short distance away the water is taken through two 24-in. vitrified tile pipes. Under the lagoon the tunnel is 6 ft. by 6 ft., with board walls.

FIG. 21.—A NIGHT EFFECT NEAR ELECTRICITY BUILDING.

The intake for the condensers, which runs from the lagoon to the Machinery Building, is of 36-in. vitrified pipe. This pipe is 400 ft. long over all. Water runs through it by gravity to four cold wells in the Machinery Building, from which wells it is drawn by the condensers. Two of these cold wells are 8 ft. by 8 ft., and two are 14 ft. 8 in. by 14 ft. 8 in.

The Cascade pumping plant is to consist of three 2,000-hp Westinghouse induction motors running at 365 r.p.m., direct-connected to Worthington centrifugal pumps, each with 36-in. discharge and 40-in. suction. The water will probably be pumped over the Cascades at the rate of about 15,000 gallons per minute. The total fall is about 154 ft.

DISTRIBUTION FOR LIGHT AND POWER.

This is to be an exposition of "magnificent distances." The distribution of electric light and power will, therefore, be carried on along much the same lines as the distribution for electric light and

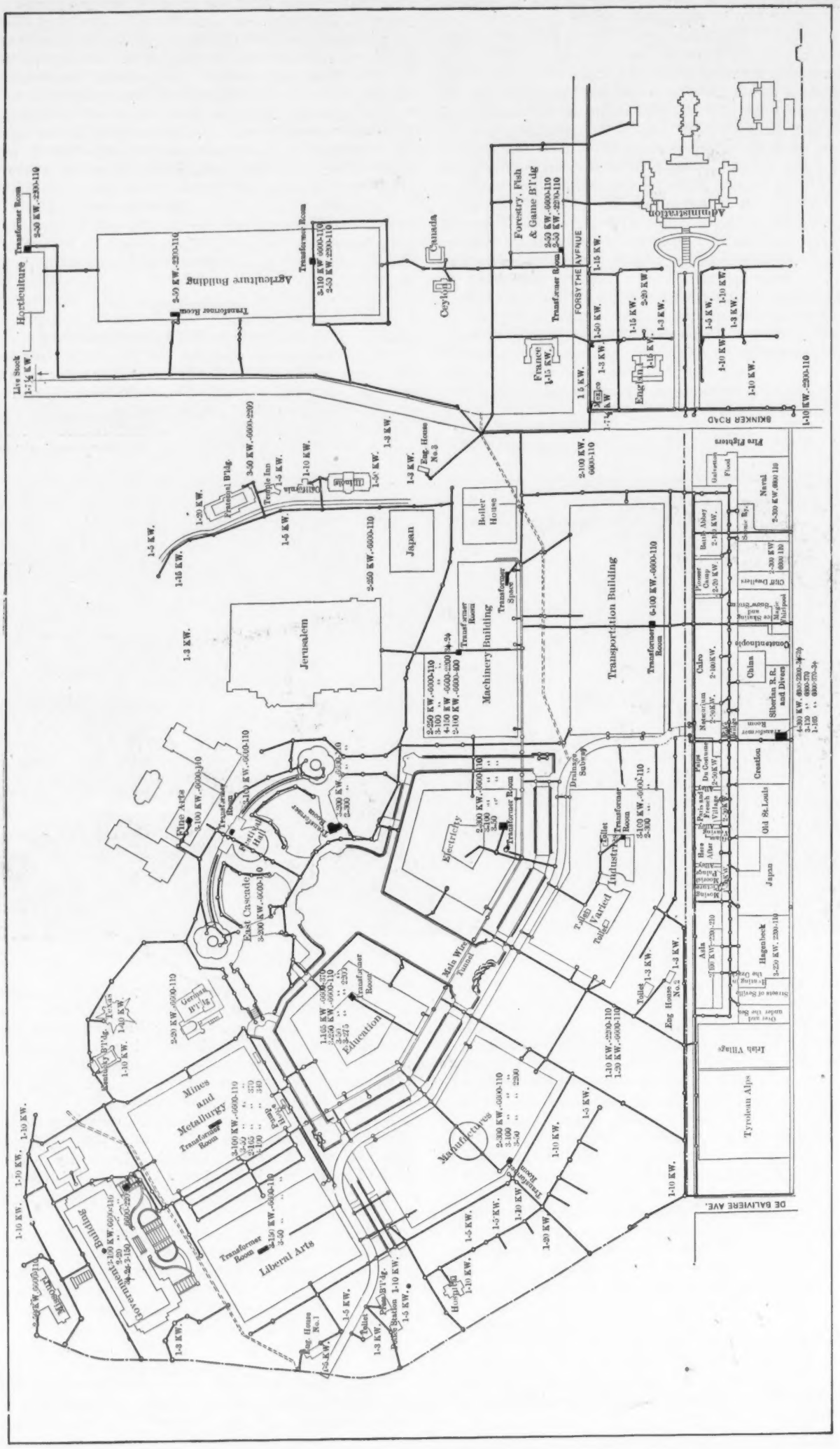


FIG. 22.—GROUND PLAN OF THE LOUISIANA PURCHASE EXPOSITION.

Showing Distribution System with Location of Power Plants, Sub-Stations, Transformer Rooms and Output Capacity.

power in a large city. As said before, most of the current available is in the shape of 6,600-volt, 25-cycle, three-phase current. From a large switchboard in the west end of Machinery Building, through which switchboard all current used in the service of the exposition must pass, the distribution is by lead-covered cables in pump log ducts.

In each building will be a sub-station consisting of a transformer room and switchboard. If direct current is required, a rotary converter will also be placed in the sub-station.

About 5,000 kw is to be used on the decorative lighting of the exterior of the buildings. Each of the large buildings will have a separate feeder supplying the transformers for the decorative lighting of that building. The decorative lighting will be run on a 400-volt, four-wire system of distribution. From the four-wire distributing centers two-wire circuits, carrying about 1,300 watts each in 8-cp lamps, are run. Most of the wiring for decorative lighting is on knob and in tube. Open work has been wired with slow-burning weather-proof insulation on the wires, and concealed work has been wired with rubber-covered wire.

The interior lighting of buildings by the Exposition is designed simply to be sufficient for patrol purposes. Additional lighting will be contracted and paid for by individual exhibitors, according to their needs. The lighting of building interiors is to be done by 50-cycle, alternating-current enclosed arcs. These arcs are to be 6.5 amp., run on circuits of about 3,500 volts maximum. The constant-current transformers for arc lighting are to be located in Machinery Building. About 1,200 kw is to be used in such arc lighting. This lighting will be run from alternating-current generators in the exhibitors' power plant. A limited amount of 110, 220 and 500-volt direct current will be available in each principal building. The three-phase alternating-current circuits for general commercial uses in each building, such as exhibitors' lights and motors, will be supplied by a feeder to each building run independently of the decorative lighting for that building.

It is the intention to use the current supplied by the Union Light & Power Company on the decorative lighting. The Union Light & Power Company's current is thus taken first to the main switchboard in Machinery Building over three feeders. Where these feeders enter the Fair grounds there is a terminal house, in which are located water rheostats, which will be employed for putting the decorative lighting load on gradually. This same plan was tried at the Pan-American Exposition at Buffalo with great success, both from the standpoint of the public and that of the operating engineers. The gradual bringing up of all the decorative Exposition lighting from darkness to a full brilliancy was one of the most popular and beautiful features of the Pan-American Exposition. This method of bringing on the load was also highly desirable from the power company's standpoint, as it gave the governors time to act and obviated strain on the apparatus.

The great switchboard extending entirely across the central bay in the west end of Machinery Building is designed for the control of all the 6,600-volt, three-phase current used on the Exposition grounds. It is a brick masonry structure supported upon timber work and occupying a height of two galleries. It consists mainly of feeder panels, as most of the generator panels will be located near the machines which they control. The four generators in the service plant have control panels in this switchboard. There are in all 17 feeder panels, four generator panels, three total load panels, three exciter panels, two incoming feeder panels from the Union Light & Power Circuits, and one rheostat panel for controlling the water rheostats employed in connection with the decorative lighting. This board has been built in a very thorough manner, as the handling of such high-pressure current would be inadvisable around anything in the way of a make-shift. It was designed by the staff of the Exhibition in association with the Westinghouse Electric & Manufacturing Company, and the actual construction of the board was under the direction of Mr. K. Nurian. The features of safety and quick handling have been carefully attended to and the board is in itself a worthy exhibit of some of the latest developments in this branch of electrical work.

During the last week or two a large proportion of the service above described has gone into successful operation, and as many of the pictures furnished show, the illumination of the buildings is attended by some very rich and beautiful effects. All the work in Machinery Hall has also been pushed vigorously and the large plant there has already taken shape. It will not be long before the equipment is all in full running order.

The World's Fair Machinery Display.

By Lieut. G. L. Carden, U. S. Revenue Service.

THE late President McKinley declared that expositions are the landmarks of progress, and these memorable words uttered so shortly before his death are strikingly emphasized by the opening on the 30th day of April, 1904, of the greatest Exposition the world has ever seen. This Exposition has for its historical motive the commemoration of the centenary of the purchase from France of the Louisiana territory, and because of its geographical fitness with relation to the acquired territory St. Louis was early selected as the logical site for the holding of the Exposition.

The World's Fair, of 1904, covers 1,240 acres. The World's Co-

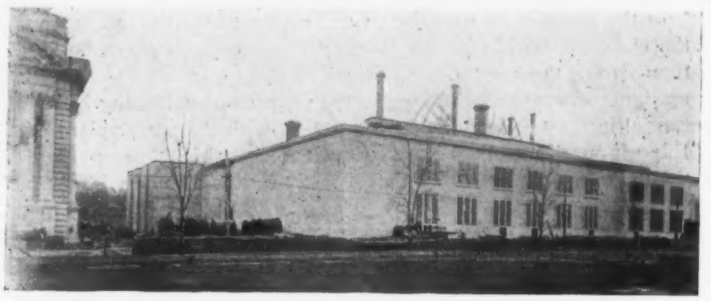


FIG. 23.—BOILER HOUSE.

lumbian Exposition at Chicago covered 636 acres. The exhibit buildings at Chicago embraced 82 acres of housed flooring. The main exhibit palaces at St. Louis have under roof 128 acres, and in addition more than 100 acres have been set apart for outside exhibits. With the foregoing facts in mind let us consider the machinery display of the Exposition.

The Machinery Department at St. Louis embraces exhibits collected from the masters in trade. This is the policy which was inaugurated from the first by Mr. Thomas M. Moore, chief of the Department of Machinery, and it has been successfully carried forward

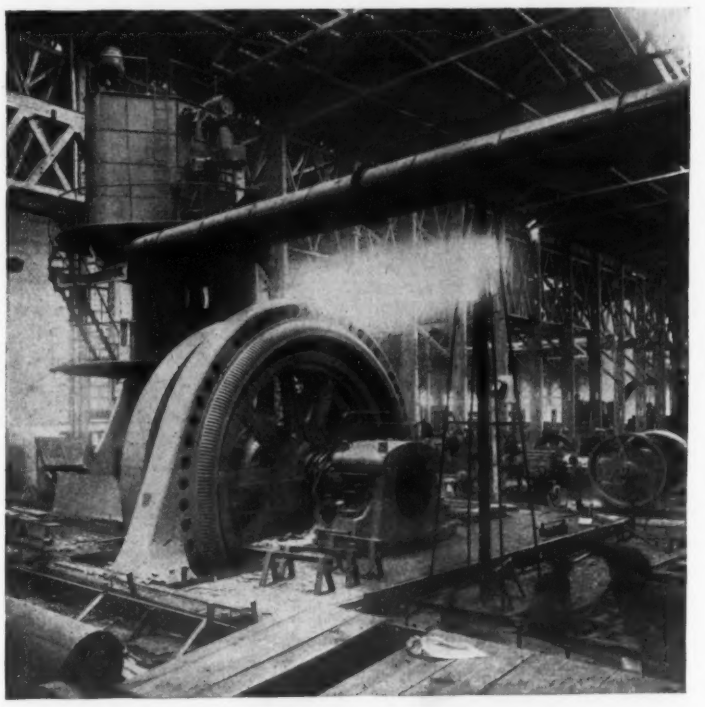


FIG. 24.—ALLIS-CHALMERS ENGINE, MACHINERY HALL.

to a final issue. The floor area in the Machinery Department embraces something like nine acres, and nearly a year ago this total floor area was applied for many times over. With Mr. Moore the idea has been uppermost that a duty existed with reference to both the trade and the public, and that a broader policy should be pursued than the mere filling of the floor space with a confused mass of odds and ends of machinery. The idea has been to secure only the latest and the most up-to-date items, and with this object in view only the leaders have been encouraged to make displays. The Machinery Hall is a superb structure measuring 1,000 ft. in length, and for at least

half of this distance its width is 500 ft. In the eastern half of the building is installed the great power plant of the World's Fair, involving something like 45,000 hp. In the western half of the building is installed machinery for making machinery. In close proximity to the eastern end of Machinery Hall is the Steam, Gas and Fuels Building. This is a steel, fire-proof structure measuring 320 ft. in length by 300 ft. in width, and comprising within its enclosure all the steam and gas generating forces for the great power plant. For the first time in Exposition history, an exhibit feature has been made of this adjunct of the power assemblage, and at St. Louis the visitor will find boilers of the latest types from different countries of the world all working in unison. All stoking will be mechanically operated, and it is aimed to have the building as free from dust and dirt as modern mechanical appliances can make it.

In the summer of 1902 the writer, acting under the instructions of the chief of the Machinery Department, began a systematic inspection among the most distinguished of the great iron and steel and machinery houses of Europe for the purpose of collecting items of a special interest for service in connection with the power plant of the Exposition. More than 350 plants were visited in Germany, and the total number of plants visited or directly communicated with throughout Europe totaled more than 1,000. As fast as offerings were secured of desirable topics the facts were reported to St. Louis, and the acceptance or rejection of the same rested with the chief of the machinery display. So keen were the European builders of machinery and accessories to make exhibits at St. Louis that it is the firm belief of the writer that had it been necessary practically all the horsepower that might have been required could have been secured from the Old World. As the situation now exists, the great power plant at St. Louis will embrace some superb engines, boilers and accessories, which have originated from abroad, and it will be especially interesting to observe that in the items which come from the Old World their distinguishing features will be in economical attachments and economical devices. The German exhibits will show the superlative in what has been attained in economics, and the writer cannot refrain from remarking that the man is very blind indeed who can travel to-day among 350 German iron, steel and machinery works without seeing much to learn. It must not be forgotten that Germany's position in machinery development has practically been taken within the past decade, and so great has been this advance that to-day the transatlantic ocean record is held by a Stettin-built ship, the *Deutschland*. When this great vessel made her record run to the eastward, a record which stands to-day, the story is told that on entering the first English port she hoisted to her mast heads a great band of canvas stretching between her foremast head and mainmast head, and on this big banner of canvas in huge black letters, which could be read with the naked eye more than a mile distant, was this inscription: "Made in Germany." The German exhibits at St. Louis in the Machinery Department will call for the most careful study on the part of the visitor, and so keen have been the German manufacturers to make displays that it is not at all uncertain that the Machinery Hall could, if desired, have been filled with German exhibits alone.

But for the superlative in the high-speed steam engine line, the visitor will naturally turn to machines bearing British stamps, for it is a fact that in the high-speed steam engine line the British lead in the world to-day. This statement, it must be understood, applies to engines of large power; and despite the magnificent showing of engines at the Dusseldorf Exposition there was no high-speed steam engine there comparable to the engines of large power such as are turned out by, for example, Behlis, of Birmingham; W. H. Allen & Co., of Bedford, England, or Willans & Robinson, of Rugby, England. In the machinery display at St. Louis there will be found a beautiful engine of the last-named make furnished through the medium of the American builders of this machine, the C. H. Bradley, Jr., Co., Pittsburg, Pa.

FIG. 25.—GENERAL VIEW OF MACHINERY HALL.

In his inspection of the various shops abroad, the writer found the most marked difference between home and foreign shop practices. At the great Krupp works at Essen car wheels were observed being loaded onto trucks by hand. In fact, there appeared to be as a general rule a lack of labor-saving devices at least to the extent with which one is familiar with such equipment in American shops. Take, for example, the Curtis system of overhead trams. Although one does find tram systems in some German shops, still the writer found no such superb installation schemes as one observes, for example, a the Illinois Steel Works shops near Chicago. In the Machinery Hall display there will be found an exhibit of this overhead system of tramway runs. In one of the first boiler shops in all Germany the writer observed that the work was carried on for the most part by hand. It seemed almost incredible, especially when one considers the possibilities afforded to-day by pneumatic tools. In the machinery tool end of Machinery Hall there will be a very fine display of pneumatic tools.

Ten years ago one might have traveled up and down the Rhenish

provinces and in all the principal German shops one would have found for the most part English machine tools. To-day all this is changed, and in lieu of English tools one finds for the most part German stock tools, but one also finds almost invariably, in all the leading German plants, a small group of American machine tools for the high-grade work. It is a silent tribute to the excellence of our output.

Among the various makes of American machine tools which the writer observed abroad those of the Niles firm were very much in evidence, and this house will make a diplay at St. Louis which will excel anything of the kind ever heretofore attempted. Some of these Niles tools for the Machinery Hall exhibit will weigh not less than 300 tons. There will be, for example, a huge universal radial drilling machine, capable of drilling to the center of a 20-ft. circle. Then, there will be a great horizontal boring, drilling and milling machine, with adjustments admitting of test readings in thousandths of an inch. All these Niles tools will be motor-driven, and in this connection the writer is reminded of a remark recently made to him by a leading German manufacturer, which was in effect that the presence of a belt on a machine tool to-day was an occasion for an apology. The Niles firm will also show a massive steam hammer, its ram and attached parts weighing 24,000 pounds. Then there will receive the pipes, one of which is 18 in. in diameter, another 16 in., and none less than 10 in.

In taking note of the handling of material in foreign shops, the writer found electric cranes in general use, but he found no crane service quite as rapid as, or more efficient, than that afforded by the best American cranes. In Machinery Hall there will be a number of electric traveling cranes, and one of the most interesting of the lot will be a superb Shaw crane. As is well understood, such cranes have played a most important part in the development of modern heavy manufacturing, and the makers of the Shaw crane were practically the first to utilize the three-motor service. This type has been in use in the United States ever since 1889. It is an interesting fact that the greatest difficulty is not met in designing a crane that will hoist a load, but in providing means for lowering it rapidly and at the same time keeping it under perfect control. This is accomplished by means of an automatic load brake. Different types are used, but the essential feature of all is that the weight of the load applies the brake, and running the motor in the lowering direction releases it, either entirely or sufficiently, so that it slips and allows the load to descend. A magnetic brake is also provided.

All the principal electric manufacturing houses in America have

FIG. 26.—GENERAL VIEW IN MACHINERY BUILDING.

be a 120-in. engine lathe and an enormous plate-bending machine, capable of bending a plate 20 ft. long by one inch thick, or its equivalent, and as a further contribution there will be found an extra heavy planer designed for planing armor plate and other work requiring the greatest power. The shipping weight of this last machine, alone, with a 35-ft. table, is 300 tons.

Space will not permit in this article to enumerate all the topics in Machinery Hall, but with reference to the boiler display it can be said roughly that the exhibit will include generators from practically all the distinguished makers of both the Old and New World. Among the names are Derr, Belleville, Conti, Niclausse, Aultman-Taylor, Babcock & Wilcox, Cahall, Clonbrock, Hohenstein, Geary and others. As an idea of what work is demanded of the boilers, it may be interesting to know that when the generators are working at full load they will evaporate 700,000 pounds of water per hour. This means that 350 tons of water will be hourly changed into steam, pass through the engines, return to the form of water by passing through condensers, and then be re-delivered to the boilers to be again transformed into live steam. The steam from the boilers before reaching the main engine must be conveyed through pipe lines having lengths some instances of 400 ft. A tunnel 7 ft. broad and 8 ft. deep will been called upon to do service in connection with the power plant. The total amount of electric energy required is about 45,000 hp. Of this amount about 32,000 hp will be delivered in alternating current at 25 cycles. This energy is supplied in varying amounts by plants all installed in the western division of Machinery Hall. One of the largest pieces of electric apparatus in this installation is a 3,500-kw 6,600 volts, 25 cycles, three-phase, engine type generator running at 75 r.p.m., built by the Bullock Electric Manufacturing Company, of Cincinnati, Ohio. This is direct-connected to a 5,500-hp single-crank compound Allis-Chalmers engine, the total height of which, including its base, is 54 ft. The total weight of engine complete and the generator is over 500 tons, the generator alone without the shaft weighing 150 tons. The overall dimensions of the floor space taken up by this generating set are approximately 35 by 45 ft. Both in the electrical and mechanical design of this machine many novel and interesting features have been embodied. The yoke is cast in four sections, securely held together by body-bound bolts; the outside diameter of the yoke is 27 ft., while its overall dimension is 33 ft., the total weight of the casting being 58,000 pounds. This machine will attract much attention.

The engine cylinders measure 44 in. for the high-pressure cylinder

and 94 in. for the low-pressure cylinder. The stroke of both is 60 in. The wheel is 25 ft. in diameter and weighs 300,000 pounds. The speed of the engine is 75 r.p.m.

Nearly all the electric generators in connection with the engines for the Intramural Railway are furnished by the Crocker-Wheeler Company, as already shown in these pages. This Intramural Railway is a double-track trolley standard gauge road some seven miles in length and equipped throughout with cars and other accessories on an exhibit basis. There is one unit of 900-kw capacity running at 110 r.p.m.; a 600-kw generator running at 85 r.p.m.; and three units of 500-kw capacity, one with a speed of 100 r.p.m., and two at a speed of 135 r.p.m. There is a seventh unit of 400-kw capacity, which will be operated at 150 r.p.m.

The Westinghouse Company is taking care of one installation of 12,000 hp, while from the General Electric Company comes, in addition to other items, a Curtis turbine of 5,000-kw capacity. This latter unit will probably be one of the most instructive in all the assemblage of great engines.

At the Paris Exposition of 1900 the pumping requirements demanded 4,500 gallons of water per minute. At St. Louis three enormous centrifugal pumps will force up, and send rolling down the face of Art Hill 90,000 gallons of water per minute. The Cascade pumps for the Exposition are supplied by the Worthington Company and the stipulations in connection with the same set forth that each of the three pumps must be capable for forcing 30,000 gallons of water per minute against a head of 158 ft. As a matter of fact, these pumps are designed for an overload of 25 per cent., which brings their maximum capacity up to 115,000 gallons of water per minute. Large volumes of water have been handled to a lesser elevation, but no such amount of water has ever been artificially moved to such a height as is required in the case of the Cascades of this Exposition.

Electrical Exhibitors at St. Louis.

We give below a list of electrical exhibitors at the St. Louis Exposition, furnished by Prof. W. E. Goldsborough, in charge of that department of the work. It will be noted that the lists for foreign countries have not been extended in full.

Adams-Bagnall Electric Company, Cleveland; A. S. Aloe, St. Louis; American Carbon & Battery Company, St. Louis; American Circular Loom Company, Chelsea, Mass.; American Electric Fuse Company, Chicago; American Electrical Heater Company, Detroit; American Electrical Novelty & Manufacturing Company, New York; American School of Correspondence, Chicago; American Telephone & Telegraph Company, Boston; the American Watchman's Time Detector Company, New York; American Watchman's Time Detector Company, Cleveland; Bion J. Arnold, Chicago; Association of Edison Illuminating Companies, Chicago; Martin Armstrong, St. Louis; Atlanta Utility Works, East Point, Ga.; the Automatic Electric Company, Chicago; Automatic Fire Alarm Company, New York City; Argentine Republic.

Baird Manufacturing Company, Chicago; Carl Bajohr, St. Louis; Bario Vacuum Company, New York; M. V. Barlow, Chicago; W. M. Bashlin, Warren, Pa.; Mrs. Alexander Baumgart, New York City; Benjamin Electric Manufacturing Company, Chicago; The Bristol Company, Waterbury, Conn.; The Browning Company, Milwaukee; The Bryant Electric Company, Bridgeport, Conn.; Bullock Electric Manufacturing Company, Cincinnati; Burdett-Rowntree Manufacturing Company, Chicago; Burnham-Williams & Co., Philadelphia.

H. B. Camp Company, Chicago; Carbondale Machine Company, Carbondale; Cassidy & Son Manufacturing Company, New York; Carman Projector & Specialty Company, Chicago; Central Telephone & Electric Company, St. Louis; Chicago Fuse Wire & Manufacturing Company, Chicago; Colonial Sign Company, Akron, Ohio; Chicago X-Ray Company, Chicago; James Clark, Jr., & Co., Louisville; A. Frederick Collins, New York; Commercial Electric Company, Indianapolis; Controller Company of America, St. Louis; Cooper Hewitt Electric Company, New York; Crocker-Wheeler Company, Ampere, N. J.

The Dayton Autoelectric Company, New York City; De Forest Wireless Telegraph Company, New York; Patrick B. Delany, South Orange, N. J.; The Dayton Electrical Manufacturing Company, Dayton, Ohio; Dialt Motor Company, Philadelphia; Dicke Tool Company, Downers' Grove, Ill.; Dodd & Struthers, Des Moines, Iowa; S. R. Dresser, Bradford, Pa.

Economical Electric Lamp Company, New York; Thomas A. Edison, Orange, N. J.; Electra Water Purifier Company, St. Louis; Electric Circulator Company, Chicago; Electric Contract Company, New York; Electric Controller & Supply Company, Cleveland, Ohio; Electric Railway Equipment Company, Cincinnati; Electric Storage Battery Company, Philadelphia; Eureka Tempered Copper Works, North East, Pa.; ELECTRICAL WORLD AND ENGINEER.

Faller Automatic Telephone Exchange Company, New York; Federal Electric Company, Chicago; C. J. Field, New York; Fort Wayne Electric Works, Fort Wayne, Ind.; France.

Germany; The Gardner Electric Drill & Machinery Company, Cleveland; General Electric Company, Schenectady, New York; Gervais Manufacturing Company, Edgewater, N. J.; G. M. Gest, Cincinnati; W. E. Goldsborough, La Fayette, Ind.; Gould Coupler Company, New York; Gould Storage Battery Company, Depew, N. Y.; Gray National Telautograph Company, New York; Gray Telephone Pay Station Company, Hartford, Conn.; A. Grothwell, San Francisco, Cal.

C. F. Hall, Chicago; Robert E. Haward, Kansas City, Mo.; The Heinze Electric Company, Lowell, Mass.; Hellesens, Enke & V. Ludvigsen, Copenhagen, Denmark; Hinton & Tarkington, Hot Springs, Ark.; Holmes, Booth & Haydens Company, New York; Holophane Glass Company, New York; C. W. Hunt, West New Brighton, New York; Miller Reese Hutchison, New York City; Hutchison Acoustic Company, New York.

Italy; Indiana Novelty Company, Muncie, Ind.; International Acheson Graphite Company, Niagara Falls, New York; J. Van Inwagen, Momence, Ill.

The Jackson Electric Drill & Supply Company, Denver, Colo.; The Jandus Electric Company, Cleveland.

Charles Kaestner & Co., Chicago; Kellogg Switchboard & Supply Company, Chicago; Kester Electrical Manufacturing Company, Chicago; Keystone Electrical Instrument Company, Philadelphia; The Kny-Scheerer Company, New York; H. E. King, Chicago; D. A. Kusel Telephone & Electric Manufacturing Company, St. Louis.

The Leclanche Battery Company, New York; Lincoln Electric Company, Cleveland; Lionel Manufacturing Company, New York; Locke Insulator Manufacturing Company, Victor, N. Y.

Mexico; McGraw Publishing Company, New York; McRoy Clay Works, Chicago; Marshall-Sanders Company, Boston; W. E. Matthews & Brother, St. Louis; The Miller Anchor Company, Norwalk, Ohio; Mystic Electric Gas Lighter Company, New York; Moloney Electric Company, St. Louis.

National Carbon Company, Cleveland; National Battery Company, New York; National Cash Register Company, Dayton, Ohio; National Electric Company, Milwaukee, Wis.; Nernst Lamp Company, Pittsburg; National Clock Works, St. Louis; Northern Electrical Manufacturing Company, Madison, Wis.; Norton Emery Wheel Company, Worcester, Mass.; Nungesser Electric Battery Company, Cleveland.

The Organ Power Company, Hartford, Conn.

Pawling & Harnischfeger, Milwaukee, Wis.; The Peerless Electric Company, Warren, Ohio; Perkins Electric Switch Manufacturing Company, Bridgeport, Conn.; The Phelps Company, Detroit, Mich.; Walter P. Phillips, Bridgeport, Conn.; Pittsburg Blue Print Company, Pittsburg; Pneumatic Signal Company, Rochester, N. Y.; Postal Telegraph Cable Company, St. Louis; Printing Telegraph News Company, St. Louis; Prometheus Electric Company, New York City; Purdue Research Laboratory, La Fayette, Ind.; Portugal.

Queen & Co., Philadelphia; F. Herrero y Ruix, Albacete, Spain.

Reynolds Electric Flasher Manufacturing Company, Chicago; The Robbins & Myers Company, Springfield, Ohio; Chicago Röntgen X-Ray Laboratory, Chicago; Roth Brothers & Co., Inc., Chicago.

St. Louis Brass Manufacturing Company, St. Louis.

The Safety Insulated Wire & Cable Company, New York; Sawyer-Man Electric Company, New York; W. Scheidel & Co., Chicago; M. Shearer, Akron, Ohio; Shedd Electric & Manufacturing Company, New York; Standard Underground Cable Company, Pittsburg; Standard Water Purifying Company, Cleveland; Sterling Electric Company, New York; Sterling Electric Motor Company, Dayton, Ohio; S. W. Stratton, Washington, D. C.; William F. Stilz & Co., Philadelphia; Sumter Telephone Manufacturing Company, Sumter, S. C.

Telephone Hygienic Company, Los Angeles, Cal.; C. H. Thordarson, Chicago; C. J. Toerring Company, Philadelphia; Triumph Electric Company, Cincinnati, Ohio.

Underwriters' Laboratories, Chicago; U. S. Incandescent Lamp Company, St. Louis; United States Electric Signal Company, West Newton, Mass.

E. C. Van Nort Electric Company, St. Louis.

Wagner Electric Manufacturing Company, St. Louis; R. V. Wagner & Co., Chicago; Waite & Bartlett, New York; Warren Ball-Bearing Fixture Company, New York; Warren Electric & Specialty Company, Warren, Ohio; Warren Electric Manufacturing Company, Sandusky, Ohio; B. F. Wasson, Clinton, Ill.; Western Electric Company, Chicago; Wesco Supply Company, St. Louis; *Western Electrician*, Chicago; Western Union Telegraph Company, St. Louis; Weston Electrical Instrument Company, Newark, N. J.; Westinghouse Electric & Manufacturing Company, Pittsburg; Wheel Truing Brake Shoe Company, Detroit, Mich.; Windsor & Kenfield Publishing Company, Chicago; Wireless Railway Company, Philadelphia; Westinghouse Traction Brake Co., New York; The Wyckoff Pipe & Creosoting Company, Stamford, Conn.

Charles E. Yetman, New York.

A Trolley Line Up Mount Vesuvius.

The famous volcano at Mount Vesuvius has hitherto been quite difficult of access from Naples, although when once the foot of the mountain was attained, the cable road has been there, beginning at the base of the lava cone 2,450 ft. above the sea and running up to a height of 3,700 ft. in the vicinity of the old crater and about 360 ft. below the new one. One can have a "hot time" there, and until recently one had a "hot time" getting there. But the great tourist firm of Messrs. Cook, who own the cable road, have now installed a very interesting trolley line from Resina on the outskirts of Naples right to the foot of the cableway, and the distance of 4½ miles is covered in 48 minutes, with all stops included.

The grades between Resina and San Vito do not exceed 8 per cent. About the same grades are found between the Government Observatory and the cable railway. It was determined, therefore, to operate both of these divisions by an electric railway. For the section between the power station and the observatory a rack road was chosen, as that division includes grades as high as 25 per cent. On this division the motor car of the electric railway is hauled by an electically-driven rack locomotive. The Vesuvius Railway, as now completed, has a gauge of 1 meter and is divided into three sections, having a total length of 4.5 miles. The first section is an electric railway starting at Pugliano (the upper part of Resina), and extending 1.9 miles to the power house and car house. The minimum curve radius is 164 ft. The second section, as stated, is a rack road, and runs from the power house to the observatory. Its length is about 1 mile and its highest point nearly 1,950 ft. above the sea. The third section is an ordinary electric railway, similar to the first, and is 1.62 miles long. The roadbed in general is built in accordance with the practice adopted on the later Swiss mountain railways.

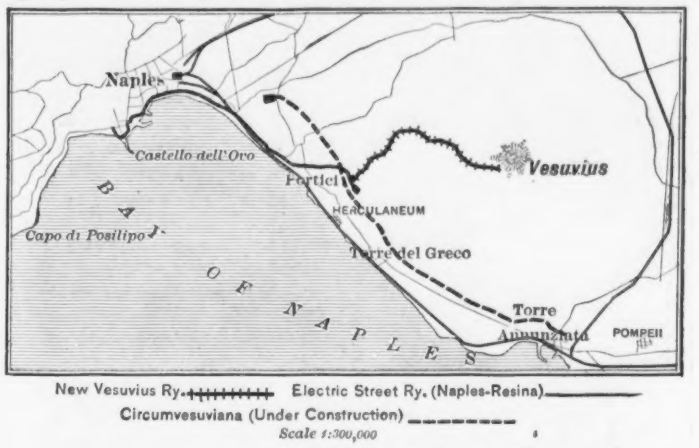


FIG. 2.—MAP OF MT. VESUVIUS ELECTRIC RAILWAY LINE.

From Pugliano the line traverses a very fertile agricultural district, and just before reaching the rack road passes through a number of petrified lava streams. The first station, San Vito, is in the middle of the garden district, about .87 mile from the beginning of the line. From this point the railway runs for 1.02 miles in an almost straight line to the rack road. The lower portion of the latter road passes through inhabited territory, but soon enters a large forest, from which it does not emerge until it reaches the observatory. The observatory railway station lies very near the large hotel which has been built at this point by Messrs. Cook. There is also close to the station a

FIG. 1.—GENERAL VIEW OF MT. VESUVIUS; ELECTRIC RAILWAY IN THE FOREGROUND.

little chapel and park. From this station the line is again of the ordinary electric railway construction, and traverses a distance of approximately 1.62 miles before reaching the lower station of the old cable railway.

The track construction of the electric line consists of rails 3.94 in.

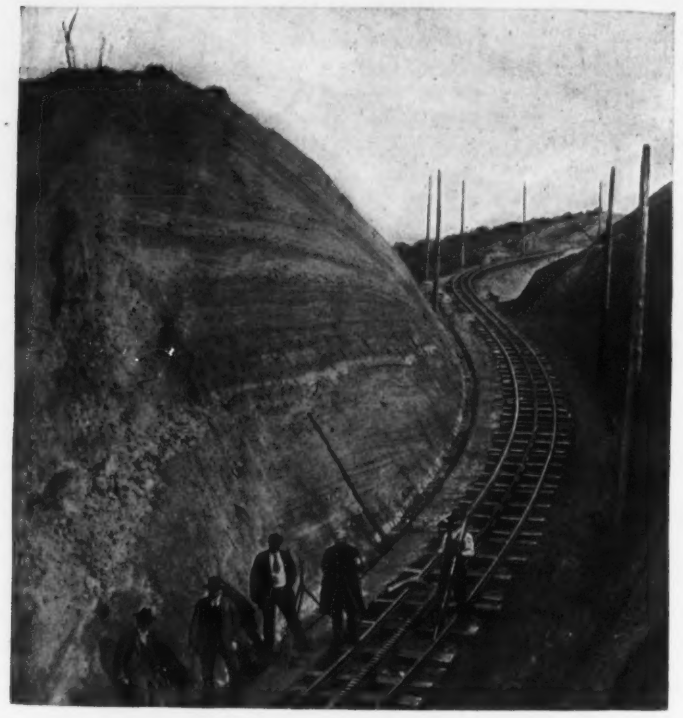


FIG. 3.—BUILDING THE RACK RAIL DIVISION.

high, weighing about 40 pounds per yard. The rack rails are laid on 11-ft. 3-in. sections, while the outside rails are 33 ft. 9 in. long. The rails on the rack road and the curves on the other divisions are anchored by means of iron tie plates. On straight track of the electric railway divisions the joints are furnished with the usual base plates as well as angle plates. Oak ties are used throughout rather than metal ones, as they can be replaced more quickly in case of lava overflows, and because the Strub rack system operates equally well with metal or wooden ties. These ties are 6 ft. long, 6.3 in. to 7 in. wide and 4.73 in. to 5.52 in. high. Plastic bonds are used for bonding in the rail return except at special work, where wire bonds are used.

To make possible a 35-minute headway turnouts have been built at each end of the rack division. The present equipment consists of three motor cars and two rack locomotives. The cars have single trucks of 6.2 ft. wheel base, and weigh 4,200 pounds (8,400 kg.) each, without motors. The motors are of the direct-current series type, and are built somewhat larger than would otherwise be required, on account of the heavy grades and warm climate. All cars are built in three sections, each of which has a separate side door. The seating capacity is eight passengers per section, with additional room for six passengers on the platform. The sides of the car are cut off half-way to the roof, but in stormy weather the openings may be closed by water-proof curtains. The cars are equipped with bow trolleys. Owing to the severe grades each car is furnished with two independent sets of braking apparatus. The first consists of a powerful spindle brake, furnished with eight brake shoes, which can be operated from either platform. The second consists of an electric short-circuiting brake combined with an electromagnetic track brake. To overcome slippery rails two sanders are supplied at each end of the car. When the motor cars are used on the rack division they are pushed by the electric locomotive, so that no brakes are required; the rack locomotive is equipped with four independent brakes, each of which is capable of controlling both locomotive and car.

The rack locomotive weighs about 5,200 pounds and is capable of running at about 5 miles per hour when propelling a load of 5,500 pounds on a 25 per cent. grade. It is equipped with two 80-hp shunt-wound motors, which run at 650 r.p.m. to 700 r.p.m., and operate the rack-driving wheels through gearing. The rack wheels are made of crucible steel and weigh about 40 pounds each. As the motors are shunt-wound, current is returned to the line when the locomotive is running down grade.

The power plant is furnished with two 67.5-kw, 550-volt, direct-current generators, running at 700 r p.m., and operated by belting from the fly-wheel of two 100-hp, 160-r.p.m. gas engines, using producer gas. The generators may be connected in parallel to a Tudor storage battery having 300 elements and a capacity of 256 amp.-hours. These generators are wired according to the C. E. L. Brown system, which enables them to deliver current to the storage battery without the use of a booster. The full-load efficiency of each generator is 92 per cent. and the half-load efficiency 89 per cent. There are two gas producers, and as each is of 200-hp capacity only one is used at a time. There are also two boilers for these producers, one of which may also be held in reserve. The gas engines are started by compressed air, but can also be started by supplying the generators with battery current and momentarily operating the latter as motors The power transmission line is divided into two sections by a section insulator, these divisions being respectively that from the power station to Pugliano, and from the power station to the cable railway. The third circuit leaving the switchboard was intended originally to be a feeder for the power house cable railway division or to furnish current for the electric motor which is to operate the cable railway. It has been found, however, that this feeder is unnecessary at present.

A circuit-breaker has been placed at the upper end of the rack railway near the observatory, dividing the power house cable railway section into two parts. In case of an eruption it will be possible, therefore, to cut off all current from the electric railway division between the observatory and the cable railway. The power circuits are protected by Wurts lightning arresters, which are mounted on poles along the line at intervals of about .6 mile. The lightning arresters are grounded through the rails. In addition to the power wires there are two telephone wires and one telegraph wire, used for dispatching and other purposes. All of the electrical apparatus throughout the system was furnished by Brown, Boveri & Co., of Baden. The general plan was that of Mr. E. Strub, of Zurich, Switzerland.

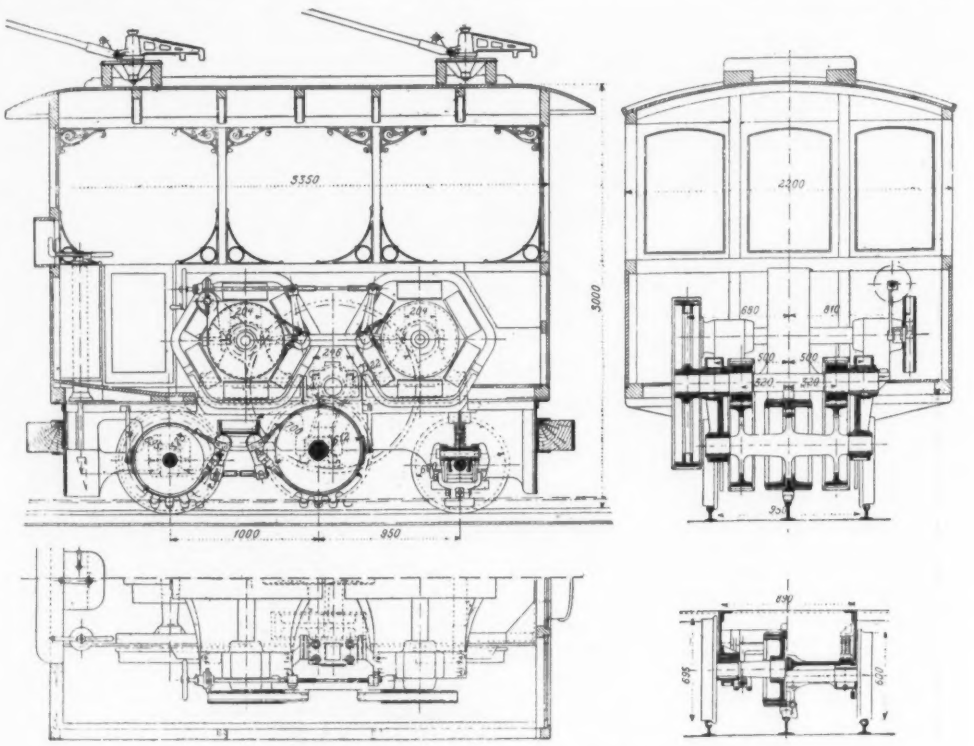


FIG. 4.—SECTION VIEWS OF ELECTRICALLY-DRIVEN RACK LOCOMOTIVE.

A Convenient and Economical Electrical Method for Determining Mechanical Torque.

BY A. S. MCALLISTER.

A LITTLE experience with the well-known mechanical and electrical methods for determining torque convinces one that the latter method is far preferable to the former with reference to ease of adjustment, flexibility of operation and reliability of results. For ascertaining the output from either mechanical or electrical motors, perhaps, the most familiar method is one which involves the use of a direct-current generator, of which the sum of the input and transmission losses is taken as the value of the output desired. The input to the direct-current generator is found as the sum of its output and its internal losses. In order to determine the internal losses of the generator, it is necessary to find the value of the individual iron, friction and copper losses. When the resistances of the separate circuits of the generator and the currents flowing therethrough are known, the copper losses may readily be calculated. The armature iron loss varies both with the speed and the density of magnetism. That the effect of any change in the latter may be eliminated, it is usual to operate the generator as a shunt-wound machine with constant field excitation and with the armature brushes at the mechanical neutral point, under which conditions the iron loss will vary at a rate but slightly greater than the first power of the speed, and, where the nature of the test so dictates, the value may accurately be determined throughout any desired range of speed.

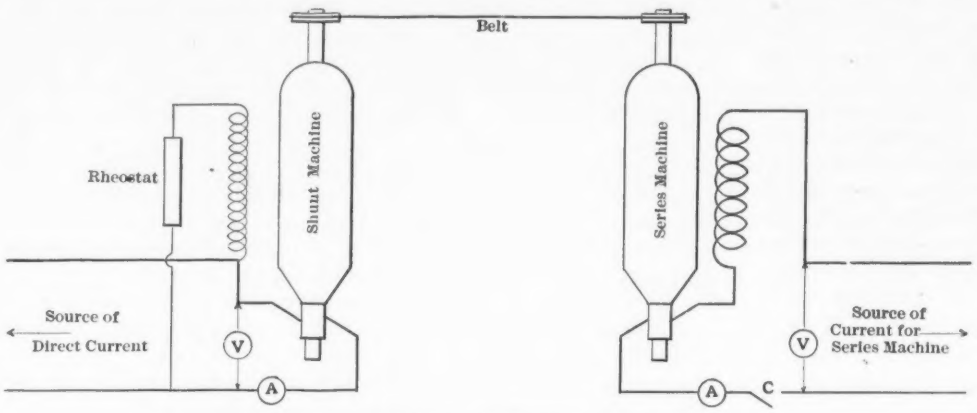


FIG. 1.—DIAGRAM OF TESTING CIRCUITS.

In cases where the load generator and the driving motor are constructed for the same e.m.f. and capacity, the output from the generator may be fed back into the supply line, the test thereby using only that amount of energy necessary to overcome the losses of the two machines. In these latter cases the individual losses of each machine are calculated as formerly and each is subject to the same errors as before, but the sum of the losses, being directly measured, is accurately determined and may be used as a check on the separate losses.

The method given below combines the convenience and economy of the "loading back" method, is subject to a less number of sources of errors and is applicable to all types of motors, either direct or alternating current, which may possess either the series or shunt motor characteristics, and in many cases it may with equally desirable results be applied to the testing of either mechanical or electrical motors.

The circuit diagram of Fig. 1 will serve to make clear the method of connecting the apparatus for the test and may be used to explain the theory upon which the test depends. In Fig. 1 the load generator is shown as a constant-potential, shunt-wound, direct-current machine, while the driving motor, as shown, is a series-wound machine, and may be of either the direct or alternating-current type. It is desired to find the torque of the series machine at various speeds. If the shunt machine be operated as a motor—being belted to the series machine which is run, with circuit switch C open, at a speed somewhat below that at which the value of the torque is desired to be obtained—it will require a certain armature current, I_0, at a certain impressed e.m.f., E. If now the switch, C, in the circuit to the series machine, be closed, the shunt machine will be driven at an increased speed and will require an armature current smaller than before—perhaps of negative value—due to the accelerating torque transmitted to the belt, and, if the e.m.f., E, and the field current of the shunt machine, remain constant, the value of the torque excited by the series machine, expressed in equivalent watts per revolution per minute, will be:

$$T = \frac{(Io - I_L)\ E}{S},$$

where Io is amp. taken by armature of shunt machine with switch, C, open;

I_L is amp. taken by armature of shunt machine with switch, C, closed;

and S is the "synchronous" speed of the set, as determined by the relation of the e.m.f. and field strength of the shunt machine.

The equation above expresses the value of the torque by which the series machine assists the shunt-wound machine, and gives the true value of the torque which the series machine delivers to its own shaft.

The convenience of this method in comparison with one which uses the shunt machine as a generator will be appreciated when it is considered that no account need be taken of the internal losses or of the output of the machine and that the field current of the shunt machine and therewith the speed of the set may be adjusted to any desired value for each determination of torque without affecting the results. The economy of the method is due to the fact that the set dissipates only that amount of energy represented by the losses of the two machines, all excess of power being returned through the constant potential supply circuit by means of the current, produced by the generator action of the shunt machine.

The accuracy of the method depends upon the following facts: A direct-current motor runs at a speed such as to generate an e.m.f. less than the impressed by an amount sufficient to force through the resistance of its armature a current of a value such that its product with the field magnetism gives the torque demanded at its shaft. With constant field magnetism the electrical torque of a direct-current machine, operated as either a motor or a generator, is given by the expression:

$$T = \frac{I\,E}{S},$$

where I is the armature current,

E is the impressed e.m.f.,

and S is that speed at which the counter e.m.f. of rotation of the armature windings in the field magnetism equals the impressed e.m.f.; that is, the "synchronous" speed as used above.

If Wo = watts output (electrical),

R = resistance of armature,

$r.p.m.$ = actual speed of armature,

then $T = \frac{Wo}{r.p.m.} = \frac{I\,E - I^2R}{r.p.m.} = \frac{I\ (E - I\,R)}{r.p.m.} = \frac{I\,Ec}{r.p.m.}$, where

Ec is the counter e.m.f. of rotation. But $\frac{Ec}{r.p.m.} = \frac{E}{S}$ for constant field strength; hence, $T = \frac{I\,E}{S}$, as given above.

Since for a certain impressed e.m.f. S has a definite fixed value for each adjustment of field strength, with constant field magnetism, the internal electrical torque of the shunt machine varies directly with the armature current, and any change in the value of this current serves at once as a measure of the change in torque exerted by the shunt machine, quite independent of all other conditions.

It remains now to show why the change in torque of the shunt machine may be used to determine the torque exerted by the driving motor. The torque delivered to the shaft of the series motor is less than the internal electrical torque of the shunt machine by that necessary to overcome the iron and friction losses of the shunt machine

and the transmission losses in the belt. Since the belt and friction losses vary directly with the speed, it will be evident that the counter torque due thereto will be constant. For constant field magnetism, the armature hysteresis loss varies as the first power, and the eddy current loss as the square, of the speed. Since in comparison with the other loss, that due to the eddy currents is relatively small, the sum of the iron, friction and transmission losses varies at a rate inappreciably greater than the first power of the speed and the torque necessary to overcome these losses may, for practical purposes, be taken as being independent of the slight change in speed. The change in the internal electrical torque of the shunt machine, when switch *C*, of Fig. 1, is closed, gives at once the value of the torque delivered to its shaft by the series motor.

The method outlined above may be used to determine the torque exerted by a machine when such torque is much less than that necessary to drive a generator of any capacity whatsoever and is, therefore, especially advantageous for tests where it is desired to find the torque, at high speeds of machines possessing series motor characteristics.

In Fig. 1 is shown a series-wound driving motor, but it will be evident that the change in torque, as given by the variation of the current taken by the shunt machine, may be produced by any type of motor. A little consideration will show that since, at any given speed, the torque exerted by the shunt machine of Fig. 1 may be adjusted throughout any desired range by use of the field rheostat, the method may conveniently be applied to motors possessing practically constant load speed characteristics, such as those of the direct-current, shunt-wound type or of the alternating-current induction type, and that alternating-current synchronous motors may be similarly tested, if after adjustment of the load on the synchronous motor by means of the rheostat in the field circuit of the shunt machine the supply of electric power be cut off from the synchronous machine in order to obtain the change in torque excited by the shunt machine.

Annual Report of the General Electric Company.

The reports of the General Electric Company for the year ending January 31, 1904, have just been issued. The financial condition is summarized in the report of President Coffin, which shows, after writing off $553,733 from patent account and $2,027,841 from factory plants and machinery a profit, less $76,007 interest on debentures of $7,789,369. From this is deducted a debit to profit and loss of $1,470,098 in writing off patents, etc., of Stanley Electric Manufacturing Company, the balance due on turbine patents, etc., making a net of $6,319,270. There was paid in dividends during the year a sum of $4,482,701, which deducted from the $10,801,972, representing last year's net profits, and the 1902 surplus of $4,482,972 left a surplus on January 31 of $7,293,688. Mr. Coffin in noting the fact that the percentage of profit was smaller in 1902 gives as reasons the disturbed financial conditions, the increased cost of copper, higher priced and less effective labor, lower selling prices and the expense of developing the steam turbine.

First Vice-President Griffin gives an interesting statement as to the business done. The total amount billed to customers reached the impressive sum of $41,699,617, as compared with $36,685,598 in 1902-3, although the orders received, due to lower prices, were $39,060,038, as compared with $39,944,454, showing that the company by increased capacity had been able to catch up with its orders. The gigantic output included about 900,000 hp of generators, rotaries and turbines; more than 7,000 railway motors aggregating over 300,000-hp capacity; transformers of over 650,000-hp capacity; more than 15,000 alternating and direct-current motors, aggregating over 200,000 hp; more than 75,000 arc lamps and 110,000 meters. General Griffin points with deserved pride to the brilliant success of the Manhattan Elevated equipment carrying over 1,000,000 passengers daily and takes occasion to point out that the "deadly third rail" did not kill or hurt a single passenger. Attention is also directed to the large order from the New York Central system for apparatus to operate as far out as Croton, 34 miles from New York City. It is shown that the percentage of operation has thus been cut down by the adoption of electricity: South Side Elevated, Chicago, 1895 steam, 69.1 per cent. of operating expenses to gross receipts; 1899, electricity, 44.1 per cent. Lake Street Elevated, 1895 steam, 56.1 per cent.; 1899 electricity, 47.5 per cent. Manhattan Elevated, 1901 steam, 55.8; 1903 electricity, 44.7. The detailed figures of the Manhattan, already familiar, are recited. General Griffin also calls attention to the great success of the Sprague-General Electric multiple-unit control now in use on 53 roads and 2,595 cars and adopted for London and Paris. The striking statement is made that since 1892 the company has sold 92,557 railway motors of a total capacity of 3,420,537 hp. As to power transmission, including steam and water plants, the company has installed or under contract 1,230,270 hp in polyphase generators, of which 514,910 hp is driven hydraulically. The number of orders received during the year was 176,834, or about 570 per cent. It appears elsewhere in the report that there were 15,500 regular customers on the books—more than 1,000 increase over 1902-3. General Griffin does not give the output of incandescent lamps.

Vice-President Rice presents an interesting report from the production end. The floor space has increased 700,000 ft. in 1903 and is now 3,700,000 ft., as compared with 1,800,000 ft. in 1899. The employees are 17,000, as compared with 8,000 in 1899; but are 1,000 fewer than in 1902-3, a fact that may quite largely be attributed to increased use of automatic machinery. To the incandescent lamp factory at Harrison, N. J., 4,200,089 ft., were added. The new turbine shop at Schenectady is 237,000 sq. ft., and one for the same work at Lynn has 137,000 sq. ft.

Mr. Rice notes the average increase of transformers in transmission plants from 100 kw to 1,000 kw, and the maximum size from 300 kw to 2,500 kw. The company had five large plants under construction with line pressures of 60,000 volts. One interesting item is the order from the government of Mysore, India, for 5,000 hp of generators, thus nearly doubling the original Cauvery-Kolar plant. At Niagara power plant the General Electric Company now has eleven generators of a total of 55,000-hp capacity; it has shipped the first 10,000-hp machine for the Canadian side of Niagara and has two more coming along for delivery.

Attention is called by Mr. Rice to the increase in the Baltimore & Ohio plant of two large multiple-unit locomotives; the order for 30 locomotives, each of 2,500 hp, for the New York Central, "the forerunner of many others to be placed by steam railroads," the introduction of single-phase railway motors, and the large exploitation of the Curtis turbine. "We made an arrangement with the inventor (Mr. C. G. Curtis) of this turbine a number of years ago, and as a result of his work and of that of our engineers, a type of prime-mover has been developed especially adapted for driving electrical generators. A large line of turbo-generators varying in size from 1½ hp to 7,500 hp has been developed. We have sold about 350,000 hp, of which 35,000 hp have been installed and are in successful operation. It is believed that the low cost, simplicity, small space and many other advantages of the Curtis turbine will result in a greatly increased sale of electrical apparatus." Mr. Rice mentions the fact that $2,500,000, exclusive of tools and patterns, was spent on the new shops in the year.

The financial report of the company states that outside of the Stanley "deal" the sum of $553,733 was spent on patents and patent litigation. It appears that the factory plants are carried on the books at $6,500,000. The total book value is $18,254,046, but in 11 years not less than $11,754,046 has been written off against them. Stocks and bonds of the company of a value of $24,340,000 are carried at a book value of $14,665,346, including 104 lots carried at $1 each. During the year securities carried at $1,156,812 were sold at a profit of $138,644. Collections during the year in cash exceeded $39,000,000. The unmatured and unsettled balances for the year are $14,548,450 and the total book value of all notes and accounts receivable was $15,207,480. The company had a balance of $2,046,488 engaged in work in progress on 816 incomplete installations. The office furniture, etc., of an appraised value of $166,059 is carried at $1. Finished apparatus worth $139,798 for novel uses had been delivered to various concerns subject to purchase if its operation is successful, such apparatus consigned and loaned being carried at $69,899. The company has no notes out and has virtually had no such obligations since 1895. Practically all purchases have been paid for in cash, although the company would appear to allow on an average slightly better than three months' credit to its customers, gauged by the accounts receivable. The total stock outstanding is $43,866,700, including $1,972,100 for the Stanley purchase. The total debentures is $2,131,400, including $2,049,400 for the Sprague purchase. A foot note to the financial statement by Messrs. H. W. Darling, treasurer, and E. Clark, general auditor, says: "The Stanley Electric Manufacturing Company, the stock of which was acquired by the General Electric Company early in 1903, carries a floating indebtedness of about $2,500,000, which it is proposed to liquidate in the near future." The balance sheet gives the cash on hand as $3,298,445 and the stocks and bonds owned as $14,665,346.

Chicago Meeting of the A. I. E. E.—Transmission Lines.

The Chicago branch of the American Institute of Electrical Engineers met April 26 to discuss the general subject of "High-Tension Transmission Circuits." At this meeting it was announced that the regular June meeting of the Institute will be held in Chicago on or about June 21, the programme to be confined to the transmission subjects. The date given was selected so that members could take advantage of the railroad rates to the Republican National Convention, as the meeting is expected to bring together transmission men from both East and West. Mr. James Lyman, chief engineer of the Chicago office of the General Electric Company, is chairman of the local committee on arrangements.

Mr. G. H. Lukes, general superintendent of the North Shore Electric Company, abstracted his paper on "Overhead High-Tension Distributing Systems in Suburban Districts," which was read at the New York meeting December 18 last. He also abstracted the paper of W. C. L. Eglin on "Automatic Apparatus for Regulating Generator and Feeder Potentials," which was read at the same New York meeting.

In discussing these papers, Mr. Lukes mentioned trees as an uncompromising source of trouble on overhead lines, and said that there was no tree insulator which was worth anything on high-tension circuits. The only way out of the difficulty was to keep the lines entirely away from the trees. As to the recent suggestion of the fire underwriters that crossing of overhead lines be made with poles so high and of such a short span that a wire breaking at one pole should not hang down far enough to reach the line crossing below, he did not think this advisable, because poles high enough to accomplish this would make the weakest point in the line. He thought it better to take some other risk than to introduce such weak points in the line. The grounded network of guard wires under the high-tension wires, if made sufficiently strong, would cause a serious additional strain on the pole supporting it, which he considered an element of danger.

Mr. H. B. Gear gave some of the practice of the Commonwealth Electric Company as regards constant-potential, alternating-current distribution lines. He said that in former days when circuits were operated at 1,000 volts and when there would be not over 20 or 25 kw load on a branch circuit, link fuses on a porcelain base for branch circuits were tolerably satisfactory; and when these fuses blew they caused no more inconvenience than the cutting off of service on that branch until a lineman could replace the fuses. On the present 2,000-volt circuits, however, the load on a branch was likely to be from 50 to 70 kw. The blowing of fuses on a 2,000-volt circuit of this capacity nearly always resulted in the destruction of the fuse box. Enclosed fuses were good, but when exposed on a pole line for some months the filling of the cartridge would become packed and the results when the fuse blew were nearly as bad as with an open fuse. The question, therefore, resolved itself into using as few fuses as possible. This company had adopted the practice of connecting various circuits solidly into junction box distributing centers without fuses. Small branch circuits were sometimes fused, the first pole away from the junction box, but the station fuses on a feeder were mainly depended upon to open short-circuits, and in case of a short-circuit on the lines, all of the customers on a feeder would be cut off for two or three minutes, while a fuse was being replaced at the station, as against the old arrangement of cutting off possibly one-third of the consumers on a feeder for two or three hours, while the lineman could reach the fuse box and repair the damage, perhaps being obliged to put a jumper around the destroyed fuse box.

Lightning arresters give satisfaction, but must be cleaned and repainted often. When old the collection of rust and dust is likely to cause trouble. They must be cleaned and painted at regular intervals. It is the custom of some companies to disconnect lightning arresters in the fall, connecting them up again before the spring thunderstorms. In a large system regular inspection of arresters by inspectors is absolutely necessary to good service. The greatest trouble which is found with wires is caused by boys, as they threw light wire across the lines with highly fascinating results. With the use of a suitable hook, an inspector could remove strings thrown across the line which were likely to cause trouble. He criticised the location of the various circuits on a pole which was suggested by Mr. Eglin. That arrangement was to place the alternating-current distributing circuit on the top cross arm, leaving arc circuits on the lower and outside arm, with the idea that these circuits would be dead during the day and that the lineman could work upon them. Mr. Gear said his company found it more satisfactory to place the alternating-current distributing circuit on the lower cross arm, where taps to transformers could be easily taken off and brought direct to the transformer. If the distributing circuit was placed on the top cross arm it was very difficult to make transformer connections to it. Furthermore, this distributing circuit was the one upon which most of the work had to be done, so that it was desirable to have it in the handiest place.

This company made an inspection of the oil in transformers about a year ago, and found that a large per cent. of them needed filling, the oil being from three to ten inches low. Many cases of transformer burn-outs were due to the absence of oil in transformers.

As regards the use of head guys from one pole to another, he considered them worthless as protection against wind storms, and cited examples of pole lines in Chicago protected by head guys, which had entirely gone down where pole lines alongside protected by side guys had remained intact.

Mr. E. P. Warner, chief engineer of the Western Electric Company, in discussing question of guys and their insulation, thought that no strain insulator was made which would protect a guy wire from circuits of 1,000 volts and over. Guy wires should all be grounded. He also thought that confidence should not be placed on an absolute cut-out on a series arc lamp, but that the lamp should be treated as if it were connected to the line.

Mr. Lukes agreed with Mr. Warren that guys should be grounded and that no dependence should be placed on absolute cut-outs in a large circuit. His instructions to men were to use an insulating stool whenever handling arc lamps on a live circuit. If it was a rainy night it was best to leave the lamp out all night than to risk handling it even then. For a strain insulator in a guy wire he thought a long stick of wood soaked in some water-proofing compound the best thing yet proposed.

Mr. J. D. Nies, instructor in Lewis Institute, gave an abstract of a paper by Harris J. Ryan, on "The Conductivity of the Atmosphere at High Voltages," read at New York, February 26, 1904. This paper was discussed by Prof. C. E. Freeman, of Armour Institute.

The paper on "European Practice in the Construction and Operation of High-Pressure Transmission Lines and Insulators," by Guido Semenza, read in New York, February 26, was given in abstract by W. A. Blanck.

Mr. Blanck said that the designing engineer in this country has been brought to seriously consider a more substantial pole line construction, which consideration culminates in the question of wooden versus iron poles. Most of the troubles on the present high-tension lines in this country with wooden poles and cross arms can be traced to the following causes: 1. Breaking of insulators. 2. Burning of pins and cross arms. 3. Damage to wooden poles by lightning, prairie or incendiary fires, and also loss by theft where fuel and building materials are scarce. A transmission line with iron poles set about 600 ft. apart reduces the number of line supports to about 20 per cent., as compared with that of wooden poles. It is, therefore, obvious that the points where break-downs may occur are reduced at the same rate, and considerably less maintenance is required. Difficulties as noted under two and three are avoided with iron poles and cross arms. The insulating capacity of a wood cross arm, in case of a broken glass insulator, for line potentials from 40,000 to 60,000 volts seems often to be overestimated. A proper form of porcelain insulator, made up of very tough material, firmly cemented to an iron pin, which, in case of a shot or blow, is not completely shattered but only chipped, will surely prove just as satisfactory as the above-mentioned insulating properties of the wooden cross arm. If the iron poles are set 600 ft. apart, the sag for the hard-drawn copper wire or cable should not be less than 2 per cent. of the span, or 12 ft. at 10° F., allowing the factor of safety to be about four. At 100° F. the deflection of the wires will be 20 ft., thus requiring 45-ft. towers. Assuming that the strongest wind sway takes place at the highest temperature just before a thunder storm and spacing the wires in an equilateral triangle with 7-ft. base, a contact of the two lower wires swinging in opposite directions could occur with only 10° deflection over the vertical plane. This deflection is very small and involves a great risk, and a considerably larger spacing would require very heavy cross arms. A suitable staggered position of the wires determined by the striking distance of the line pressure appears more advantageous for spans of 600 ft.

The tendency in this country is to build steel poles for power trans-

mission lines, with a much larger base than the cuts indicate in Mr. Semenza's paper, thus doing away with the extra concrete foundations and considerable labor in erection of the poles. In order to keep the poles free from rust, all steel parts should be heavily galvanized after all punching, shearing or other machine work is done. Such a manipulation involves a higher first cost, but reduces immensely the maintenance or renewing of preserving paint.

Looking over Mr. Semenza's comparative figures for wooden vs. iron poles, the peculiar item for right of land occupation is to be noted. This differs materially from conditions in the United States. It is not considered good practice here to secure less than a full right-of-way for the complete transmission line, because nothing short of this enables the patrol gang an easy access to all parts of the line. In general, the territory for power transmission lines in the United States is more scantily settled and heavily wooded than abroad, so that highways are the most favored routes, allowing the best access to all parts of the line with the least expenditure for the right of way. These conditions for full private right of way require, therefore, the same investment for wooden and iron poles, and the table corrected for American prices and iron poles as specified would be as follows:

53 wooden poles, 35 ft. with cross arms and pins	$6.00	$318.00	9 steel towers with cross arms and pins 45 ft.	$60.00	$540.00
Erection	1.20	63.60	Assembling & erection	7.00	63.00
3x53 insulators	1.50	238.50	3x9 insulators	1.50	40.50
		$620.10			$643.50

"These figures certainly bespeak for the iron poles most careful consideration in long-distance transmission work. Through the courtesy of Mr. Dyer, of the Aermotor Company, Chicago, I am pleased to be able to show you this evening some lantern slides of steel towers built by this company for the Guanajuato Power & Electric Company, Mexico." (See Figs. 1 and 2.)

Mr. L. A. Sanford, who was connected with the construction of the Guanajuato 100-mile steel tower transmission line, then gave a very

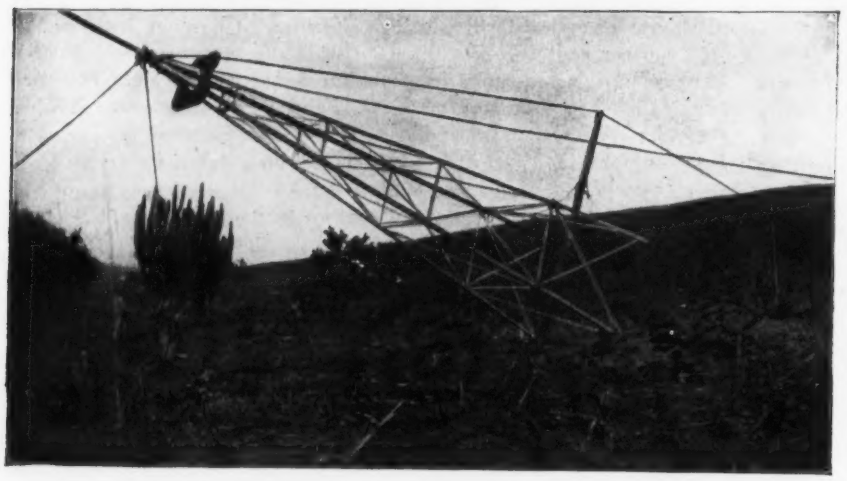


FIG. 1.—RAISING A TRANSMISSION LINE TOWER TO POSITION.

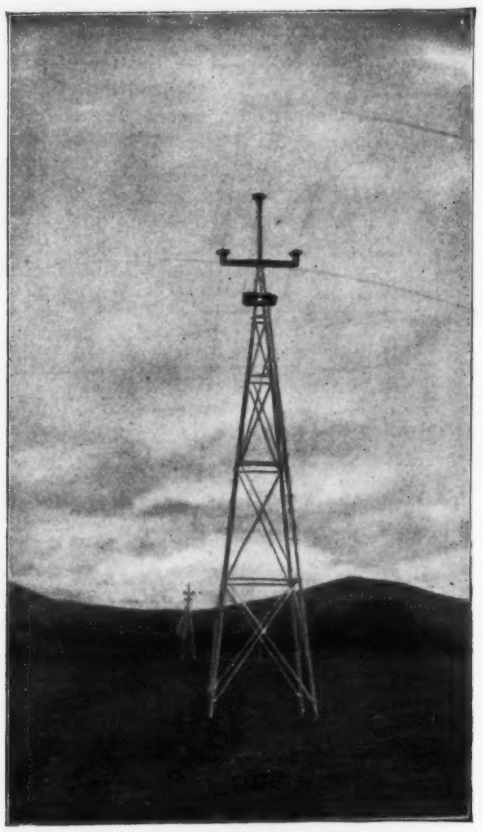


FIG. 2.—ONE OF THE TRANSMISSION LINE TOWERS.

interesting description of this new departure in transmission line construction. From the power house at Zamora the line passes through thirty miles of rough mountainous country covered with lava rock and cut by deep ravines. The remaining seventy miles lie in a clear rolling country mostly under cultivation. With the exception of a few angles near Guanajuato, the line is almost straight. Three methods of construction were available: wood poles, iron poles and towers. Since native timber is not durable enough for pole line purposes, and Texas timber is expensive to import, many high-tension lines in Mexico are built of tubular steel poles.

As the line was one of the vital points of this installation, it was desirable to make it both electrically and mechanically as strong and durable as possible. Each insulator of a high-tension line is liable to puncture and breakage, and is, therefore, a point of weakness. By long spans the number of insulators and consequent weak points may be decreased, but it is necessary at the same time to increase the strength of supports and cables.

The Locke insulator used (see ELECTRICAL WORLD AND ENGINEER, January 24, 1903), consisted of three pieces. The pin sleeves and petticoats already cemented together were shipped in barrels separate from the tops. After arrival on the line, the two parts of each insulator and the pin had to be cemented and allowed to stand for forty-eight hours before they could be distributed to the respective towers. The tower construction requires 108 insulators less than a wood pole construction with forty-eight poles to the mile. Here is a large saving in cementing the insulators and in breakage, as it is almost impossible to pack large insulators in baskets on mules and burros for two or three miles without some damage.

Transportation was a big item, both from the States and after the material was unloaded from the cars. On the rough section of the line wagon roads were very scarce, and it was often necessary to pack construction materials for four or five miles over rough trails. The Guanajuato towers (Figs. 1 and 2) weigh 1,500 pounds apiece, and are of the four-post wind mill type, standing 40 ft. above the ground, on a base 8 ft. square. As in wind mill towers, about the top is a square wooden platform extremely convenient to work on. The top insulator pin screws on the end of a 3-in. iron pipe extending 6 ft. above the top of the tower. The two 4-in. channels forming the cross arm clamp about the base of this pipe, and the square bases of the cross arm pins fit between these channels. The towers are not set in concrete, as is sometimes the custom with iron poles, but the four legs each carry a 3-in. piece of angle iron, which rests on the bottom of the post holes. These cross pieces answer the purpose of both supports and anchors. The four post holes are filled and tamped in the ordinary manner.

At the present price of steel, the tower weighing 1,500 pounds complete with cross arms and pins, in lots of 500, cost $53 apiece. They are claimed to withstand safely a transverse strain of 3,500 pounds applied at the apex. Locke insulators No. 329, as used, cost approximately $1.50 each; thirty-six insulators at $1.50 and twelve towers at $53 bring the cost of insulators and towers to $690 per mile. The cost of excavating for these towers consists of the following items: First, excavation of four holes 1½ ft. x 3 ft. x 4 ft. deep, the cost of which will vary with the nature of the ground. Second, bolting the towers together. Third, erection of the towers.

"We found that a gang of six Mexicans could assemble three towers in a day. I do not doubt but that one man and three laborers here in the States could assemble four in the same time. In raising the towers one gang of twelve Mexicans with an American foreman frequently put up twelve towers a day. Cables of 19-strand hard-drawn copper about equal to No. 1 B. & S. came from the States on

reels, each reel containing about two miles. Every four miles along the line six of these reels were unloaded from the wagon, and the cables strung each way over rollers placed on the cross arms of the towers. Our chief trouble lay with loose strands, due to injury in shipment and improper soldering of the loose ends at the factory. When a loose strand would catch in a roller it would strip from the cable, tangle and soon wedge tight.

"Two to five miles were used to pull each cable. Seven and one-half feet of sag was allowed between towers. In the rough country the slack was pulled up every mile and held with steel guy wires until the next pull could be made. In the level country a two-mile pull gave very good results. On an average, a camp could make four miles a day stringing, pulling up slack and tying in at insulators. Some difficulty was experienced in lifting the middle cable from the cross arm to the top insulator pins on towers situated on the summits of hills. In this case the weight of the cable is considerably greater than one-half the span at each side. All insulator tie wires were of No. 14 B. & S. soft copper, the idea being that the danger of nicking the cables was less with small tie wires, and in case of the cable parting it was better to break four or five tie wires than to loosen the tower. The cables were not transposed the total length of the line, but the telephone wires situated about seven feet below the cross arm were transposed every two towers."

When the voltage was first thrown on the line five or six cracked insulators were located and replaced. These insulator faults were probably due to injury in putting up, or after the line was completed. This would certainly seem a remarkable result considering the length of the line. On one occasion the strain of two cables under line tension was thrown at almost the same instant on the cross arms of a tower, by the breaking of two steel guy wires. The only effect was to twist the cross arm slightly and raise the tower out of the ground about six inches.

Mr. H. H. Wait was chairman of the meeting and many favorable comments were made on the excellence of the discussion for which he had arranged and the way the meeting was conducted, all of the discussions being full of meat and to the point.

New Telephone Patents.

SEMI-AUTOMATIC TELEPHONE SYSTEM.

Now that the telephone density, if it may be so called, is becoming so great that even with the multiple switchboard increased to a capacity far beyond the contemplation of its originators, the number of central offices required is ominously large, many inventors are turning their attention to the problem of attaining a satisfactory telephone switchboard of an ultimate capacity commensurate with the present demands. Divided multiples have been tried and recently there have been developed purely automatic systems arranged for numbers of subscribers approaching ten thousand. Another system has now been brought forward under the name "semi-automatic," this the invention of E. A. Fuller, of New York City. In this system the subscriber's line terminates in answering jack and line lamp at the central office, and is provided with an automatic sender at the outside end. When it is desired to send a call, the subscriber sets his sender to the desired number and starts the call, this being indicated to his operator by the lighting of his line lamp. The operator responds by cord and plug, as is usual with manual boards. She has no listening key, however, but instead a key which when thrown connects a number receiving device to the line and also automatically starts the subscriber's sender. The sender does not complete its signal, but merely records the thousands and hundreds numbers of the desired line upon the receiving device of the answering operator. She, noticing these, selects a trunk to the operator having the desired line, and completes the connection thereto, causing a calling-in lamp to light. This operator responds in a manner similar to the first, except that she receives on her recorder the tens and units digits and may, therefore, complete the desired connection and ring both subscribers. The taking down of a connection proceeds in the reverse direction, the placing of a receiver on the hook controlling lamps at the position of the connection completing operator.

REPEATER.

Under the name "Megaplex Relay," R. A. Engler, of Dubuque, Iowa, has patented a repeating system. The repeater is a multiple affair, each element consisting of an open magnetic circuit induction coil, opposed to one pole of which is an armature. This armature is supported from the diaphragm of a transmitter, which, therefore, is subjected to a vibration corresponding to the currents passing in the induction coil. A series of these units are interconnected, the primary of the first coil being connected to the incoming line, while the primary of the coil of the second unit is in circuit with a battery and the transmitter of the first unit, and so on until the last unit, the transmitter part of which is omitted. The induction coil secondaries are all wired in series and then connected to the outgoing line.

AN ODD TELEPHONE APPARATUS.

An odd telephone apparatus has been patented by M. Beck, of Minneapolis. There are three parts concerned in its working, two substation sets and an intermediate contact-maker and battery. The combined receiver and transmitter is peculiar, as the mouthpiece is of sheet iron so flanged that a recess is provided for an annular coil. The diaphragm is immediately behind the coil, the rearward surface of the flange of the mouthpiece serving as a support for it, while the inner edge of the orifice serves as the receiver pole. Contacting with the diaphragm is an insulating ring wound with bare wire. The contact of the diaphragm with this bare wire coil of high resistance depends upon the convexity of the former. The primary current is carried through this coil of wire, the shunting of its turns by the diaphragm serving to set up the undulating voice currents. The receiver coil and this transmitting contact are in series. An ear tube extends from the rear of the diaphragm for conveying the received sounds to the user. The talking currents are furnished primarily from the intermediate battery, the efficiency of transmission being controlled, it is stated, by the aid of rheostats at the end stations.

A step-by-step selective device and a receiver support are the subjects of the two remaining patents. Of these the former was invented by L. E. Brock, of Celina, Ohio, and the latter by J. A. Brown, of Warren, Ohio. Each includes the features usual with apparatus of their respective kinds.

A NEW SYSTEM OF SUPERVISING SIGNALS.

While in most cases the present standard two-lamp supervisory signal system is amply sufficient, its indications sufficiently informing the operator of the progress of a connection, there is one condition of indefiniteness included in it. The appearance of the signals is exactly the same before the called subscriber answers as it is after either one of the subscribers has, without the other, hung up his receiver; and further, while the first of these demands additional ringing on the part of the operator, the second signifies probably just the opposite, namely, that the subscriber remaining on the lines desires the operator to get him a second subscriber. It may be argued that there is little likelihood of confusion occurring in practice, because the interval of time which would usually occur between this condition of signals. However, that such confusion undoubtedly does arise is best testified to by the fact that a system of signals has been invented to overcome the difficulty. The inventor of this system is E. H. Smythe, of Freeport, Ill., the patent being assigned to the Western Electric Company. The invention lies in providing means for automatically controlling the current supply to the supervisory circuits, so that the lamp glows steadily, or gives flashes at different rates, to signify more positively the exact condition of the connections. The ringing signal is steady; a fast flash is used to indicate "disconnect," being introduced by the simple replacement of the receiver on the hook, while a slow flash is used for a "recalling signal," being introduced by the mere removal of the receiver after once depressing it. The removal of the operator's plug or her "listening-in," restores the circuits to the proper condition for subsequent use.

OFFICE DESK TELEPHONE SET.

Mr. A. R. Ferguson, of New York City, has patented a swinging arm telephone set of rather novel design, in that the plane of swing is vertical. The base is adapted to clamp upon the top of a desk, and it carries on a hinge a straight telescoping tube, upon the end of which is carried the hook switch and transmitter. A perforated ear on the receiver engages a button on the hook switch lever, and thus it hangs in a vertical position irrespective of the angle of the arm with the horizontal. The weight of the receiver is, on the other hand, effective in depressing the hook switch only when the arm is vertical. Therefore, after using the set the arm must be pushed up out of the way. The patent for this arm has been assigned to the Electro-Mechanical Specialty Company, of New York City.

ADJUSTABLE RECEIVER.

In ordinary telephone practice it is not thought necessary to adjust the sensitiveness of the receiver for different users; in fact, the

present tendency seems to be toward having no adjustment at all. However, when used to assist the deaf to hear, the sensitiveness of various ears or the different degrees of deafness, render an adjustment at times advisable if not necessary. M. R. Hutchison, of Norwood, N. J., has patented an adjustable receiver for this work, adjustment of the air-gap between diaphragm and pole faces being effected by screwing the cap piece farther or less upon the body. An arbitrary scale of adjustment enables one to reset to the same position at different times, while a friction pin lock prevents any accidental change of adjustment.

HOOK SWITCH ESCUTCHEON PLATE.

The peculiar shape of a hook switch has always rendered it difficult to use other than a two-piece escutcheon plate where it passes through the side of telephone box. This of course renders it necessary to use four screws to secure the plate. A one-piece plate has now been invented and patented by A. C. Christopher, of Chicago. In this plate a slit is cut from the slot to the edge of the escutcheon in a line at right angles to the slot for the lever. By suitably turning and twisting the plate, the lever may be threaded through the slit into the slot, the plate being temporarily distorted to permit of this. The Kellogg Switchboard & Supply Company has obtained the patent for this device, by assignment.

Some New Data on the Edison Storage Battery.

In a very interesting lecture delivered before the New York Electrical Society at the rooms of the American Institute, New York City, on April 27th, on the occasion of the Society's two hundred and forty-second meeting, Mr. R. A. Fliess, who for some years past has been associated with Mr. Edison in the development of the nickel-iron cell, outlined the steps that led up to the discovery of the Edison cell, and then described its gradual development to its present state of perfection.

The various steps that have marked progress in the development of the cell were illustrated by means of lantern slides. Several curves were shown in which are recorded the progress made in the development of the active materials at different periods in the development of the cell; also a number of photographs taken at different times during the past few years by Mr. Fliess, in which vital moments during the period of development are preserved.

Mr. Fliess began by pointing out the great amount of preliminary work that had to be gone through before Mr. Edison had reached the point in his search after a secondary cell such as he desired where he felt justified in beginning operations on a large scale. Mr. Edison set himself the task at the outset of his search after a commercial solution of the light-weight secondary cell that should possess as many as possible of the following desirable features: 1. Absence of deterioration by work. 2. Large storage capacity per unit of mass. 3. Capability of being rapidly charged or discharged. 4. Capability of withstanding careless treatment.

Mr. Fliess pointed out that among his early attempts Mr. Edison made an attempt to develop his well-known Edison-Leclanche primary cell into a commercial secondary cell, and that consequently at an early date Mr. Edison already had under close observation two of the three elements that composed his first solution of the light-weight secondary cell problem, i. e., the copper pole and the alkaline electrolyte. They, in connection with cadmium, comprised his cadmium copper cell—the first of several solutions of the light-weight secondary cell problem reached by Mr. Edison before he hit upon his nickel-iron combination.

The general method of investigation adhered to by Mr. Edison throughout his search for a solution of his problem was described and photographs of the apparatus used were shown. Mr. Edison used little pockets stuffed with the active material he wished to investigate during his early experiments. These were subjected to the oxidizing or reducing action of the electric current and were then discharged against an excess of active material of the opposite kind. By means of an elaborate system of testing Mr. Edison followed very accurately and quickly all improvements made in the ampere-hour and watt-hour capacities of the active materials, and curves were presented that showed at a glance the improvements that were made during the period in which Mr. Edison was attempting to develop the ampere-hour and watt-hour capacities of his nickel and iron elements.

In six months an increase of over 72 per cent. was recorded in the ampere-hour capacity of the nickel and over 83 per cent. in its watt-hour capacity. In another six months a 33 per cent. advance was made in its ampere-hour and a 35 per cent. advance in its watt-hour capacity; or, in other words, in the short space of one year an increase in the ampere-hour capacity of the nickel per gram was made of over 128 per cent., and an increase in its watt-hour capacity of over 148 per cent.

The improvement recorded in the ampere-hour and watt-hour capacities of the iron was equally remarkable. In six months an increase in its ampere-hour capacity of over 40 per cent. was recorded and in its watt-hour capacity of over 48 per cent.; while in another six months an increase of over 70 per cent. in ampere-hour and of over 75 per cent. in watt-hour capacity was made; or, in other words, in the short space of one year an increase of over 139 per cent. was made in its ampere-hour capacity and of over 159 per cent. in its watt-hour capacity.

During the course of this development over 10,000 separate tests were made on little test grids containing samples of iron and nickel and as between 80 and 100 observations had to be made during a single test more than 100,000 observations were made and recorded while the improvements mentioned above were being made. Mr. Fliess mentioned this to give an idea of the enormous amount of detailed work that the development of an invention of any pretentions involves.

It was not until about the first of February, 1902, that Mr. Edison had advanced far enough to make up a large-sized cell with automatic tools. About this time, however, he received at his laboratory in West Orange the first large-sized cell ever made completely with automatic tools. The mechanical parts of this cell had been made at the mechanical works at Glen Ridge, N. J., and the active materials at the chemical plant at Silver Lake, N. J.

This cell was composed of nine nickel and nine iron plates, contained in a steel jar, and covered by a steel cover through which the binding posts protruded. A number of cells soon followed and on the 3d of April, 1902, a little Baker electric vehicle equipped with

TABLE I.

Type.	Discharge rate.	Output.
C	30 amperes	229.6 watt hours
C	120 amperes	175.25 watt hours
D	30 amperes	212.2 watt hours
D	120 amperes	191.5 watt hours
E	30 amperes	272.5 watt hours
E	120 amperes	240.6 watt hours

twenty-one cells started out for a first spin in which an automobile had ever been propelled by power obtained from Edison cells. A picture of the vehicle at the moment of starting was shown.

This first type of cell was called the "C" type. It had one or two characteristics that Mr. Edison did not consider desirable, so he soon set out to produce a cell that should not possess the features of the "C" type he wished eliminated. The result was the "D" type cell. The "C" type cell, however, even though Mr. Edison did not approve of it entirely, still showed marked improvement over the light-weight automobile type of lead cell to-day. Mr. Fliess supported his statements by means of curves. The objection Mr. Edison had to his "C" type of cell was that it did not stand up well under high rates of discharge. That is to say, it lost something over 37 per cent. of its normal capacity when discharged at five times its normal rate. A lead cell under similar conditions, however, Mr. Fliess pointed out, loses over 50 per cent. of the capacity it has at its normal rate.

Some "D" type cells were ready about May, 1903, and were at once subjected to a very severe test in automobiles. This cell was composed of fourteen nickel and fourteen iron plates. It occupied the same space as did the "C" cell, but the active plate surface was over 35 per cent. greater, consequently the discharge rate should be much greater. That this was so, the curves that were shown by Mr. Fliess demonstrated very clearly. Instead of the 37 per cent. loss in capacity suffered by the "C" cell at a five times normal discharge rate, it showed but a 10 per cent. loss under similar conditions. This high discharge rate feature had been obtained, tests showed, at the sacrifice of ampere-hour capacity. Consequently, the weight per hp-hour had gone up as compared to that shown by the "C" type cell. Also, Mr. Edison found by experience that the very high discharge capacity of the "D" type cell was seldom called upon in practice. He therefore decided to build a third type of cell in which the great ampere-hour capacity of the "C" type and the high discharge rate capacity of the "D" type should be preserved in just the right proportions. The result was the "E" type cell. This cell is made up

with two nickel plates for every iron plate. In external appearance, however, it looks just like the two types it has superseded.

Its electrical properties, however, are a great improvement over the two earlier types, as the preceding table will show.

As the weights of the "C", "D" and "E" types, data from which are recorded in the table are exactly the same, a direct comparison may be made. It will be noticed that the "E" type cell is capable of giving out a greater amount of energy per unit of weight and volume at a 120-amp. rate of discharge than either the "C" or "D" types were able to give out at their normal rates of discharge.

An analysis of the figures just given in the table show the following results in pounds per hp-hour:

TABLE II.

Type.	Discharge rate.	Lbs. per H.P.H.
C	30 amperes	56.87
C	120 amperes	74.48
D	30 amperes	61.6
D	120 amperes	68.25
E	30 amperes	47.75
E	120 amperes	54.25

From the figures in Table II it will be seen that the "E" type cell is very much superior to the two types that preceded it, and would seem amply to justify Mr. Edison in his determination to delay the commercial production of his cell on a large scale until he could complete tools and factory facilities for turning out his "E" type cell in large numbers. These preparations were finally completed some little time ago.

Mr. Fliess then showed curves that illustrated very clearly the remarkable life and endurance that the Edison cell seems to possess. Curves were shown taken from a cell at different periods during the past three years and after three years of knocking about the laboratory, during which time the cell received absolutely no attention or care. The curves showed the cell to be in absolutely the same condition that it was when first tested. Another slide was shown in which curves of the 1st, 350th, 804th and 970th discharges on a little endurance test, kept running night and day at Mr. Edison's laboratory for over a year, were recorded. These curves showed that in this time absolutely no change had taken place in the capacity of the unit or in the shape of its discharge curve. Curves were then shown that had been obtained from a standard "D" type Edison cell just before and just after a 4,000-mile test in an automobile under the most severe conditions that could be imposed upon both the vehicle and the cells. The curves showed that after this severe 4,000-mile test the cell ran, if anything, slightly better than it did when first placed in the automobile; certainly a very refreshing result as compared to those we have been familiar with in the past. Curves were then shown taken from a cell that had traveled over 5,000 miles in an automobile under most severe conditions. The first curve was obtained from the cell before it had ever been put in the vehicle. The second after it had completed its 5,000-mile test. The curves showed that at the end of the test the cell gave over 13 per cent. greater capacity than it had done before it went into the vehicle.

This cell was exhibited with its can removed and the plates appeared to be in identically the same condition as new ones exhibited beside it.

A bottle was shown in which the deposit found in a cell after a 4,000-mile test was preserved. It was so small in amount that no accurate weight could be obtained of it on a scale weighing in ounces. In fact, the deposit amounted to but a few grams in weight, and, as Mr. Fliess pointed out, had probably nearly all been in the bottom of the cell before it ever went into the vehicle.

An interesting discussion followed, in which some criticisms made on the cell were directed chiefly against its great bulk and its high price. Mr. Fliess replied briefly.

CURRENT NEWS AND NOTES.

WIRELESS IN THE WAR.—With regard to the brilliant work of the little steamer *Hai-Mun* off Port Arthur, a cable dispatch from London of April 26 says: "The steamship *Hai-Mun*, on which is the De Forest wireless telegraphy apparatus by means of which dispatches from the seat of war are sent to the London *Times* and the New York *Times*, has gone to Nagasaki to clean up and refit. The *Hai-Mun* had been in continuous service for six weeks."

THE STEAM TURBINE DEFINED.—A local newspaper describing the new Westinghouse turbine plant installed at the works of the Union Metallic Cartridge Company, Bridgeport, Conn., says: "An interesting feature of the equipment is a steel turbine equipment of 3,000 hp. The turbine is a reciprocating engine with a piston rod that extends back and forth instead of in a circle and is the most modern. It is compact and takes up less room than other styles, and is now in use in many of the first-class manufacturing establishments."

A STATE TROLLEY LINE has recently been put in operation at Bismarck, N. D. The State Capitol is a little over a mile from the hotels and depots and it did not pay to operate a trolley line out to it, so that hack charges have been heavy, while on account of limited accommodation in the building many committee rooms have had to be rented in the city. Under these circumstances, which reflect no credit on the locaters and designers of the Capitol, the building is being enlarged and the State itself has equipped and is operating a trolley line with one car, while the exhaust steam from the power plant is to be used in winter for the new wing of the capitol.

AUTOMOBILE PARADE.—A parade of automobiles was given last week in New York City under the auspices of the Automobile Club of America. Over 225 vehicles were in line and double that number were ready, but a heavy rain storm spoiled things considerably, while the slow speed maintained caused many of the big gasoline touring machines to drop out on account of heating up. The line through the parks and drives included 39 foreign vehicles, and there were 8 American electrics. The commercial division traveling outside the Park made a remarkable appearance. There were nearly 80 such vehicles in line, of which no fewer than 59 were electric and 2 were combination electric-gasoline. It was a fine demonstration of electric capabilities in this direction. Mr. J. D. Rainier was marshal of this division, which included several of the service vehicles employed by the New York Edison Company.

IOWA TROLLEY ASSOCIATION.—The Iowa Street & Interurban Railway Association was formed at Des Moines April 21, at a meeting of the representatives of seventeen such companies operating in Iowa, held at the Kirkwood Hotel. The creation of this association is due to the efforts of George B. Hippee, general manager of the Des Moines City Railway. It was at first thought, as already noted in these columns, that the street railway men might join in with the Iowa Electrical Association, which held its regular annual convention in Des Moines at the same time. After a conference between representatives of both, however, it was decided that it would be better to keep the two organizations separate, with the understanding that for the present the conventions of the Iowa Street and Interurban Railway Association and the Iowa Electrical Association shall be held at the same place the same week, and made to overlap one day so that topics of interest to both lighting and railway men can be taken up that day. The officers elected were: George B. Hippee, of Des Moines, president; J. F. Lardner, of Davenport, vice-president, and L. D. Mathes, of Dubuque, secretary and treasurer. The constitution provides that the membership shall consist of companies or individuals operating street or interurban railways in the State of Iowa. The admission fee is $10 and the annual dues are $10.

LETTERS TO THE EDITORS.

Patent Law Reform.

To the Editors of Electrical World and Engineer:

SIRS:—I was much interested in your editorial on "Patent Law Reform" and would suggest an extension to its recommendations, namely, that where a patent is found inoperative, as fully one-half of the patents now in force are, the said patent shall, by the government, be declared invalid; and if a subsequent inventor should embody some of its features in an operative device, he shall be allowed a patent thereon as though the invention were new in all of its details. Many of the inoperative patents now in force are a bar to useful invention. It is true that even now, if one can prove a patent inoperative, it may be annulled, but this is an expense that the majority of inventors cannot afford.

In conclusion, I may call attention to the fact that the State will now pursue a horse thief and try him in court and imprison him at the expense of the State; but if a party pirates an invention, for the patenting of which the inventor has paid all that the government

demands, he must, at his own expense, bring suit to secure the right which he is told in his letters patent the government has granted for his money. This seems to me wrong in justice and equity.

BELLEFONTAINE, OHIO. D. F. TANGER.

Our Patent System.

To the Editors of Electrical World and Engineer:

SIRS:—Your impressive editorial on April 16 on "Weak Spots in the Patent System" deplores the absence of any provision of law compelling patents to be worked as a condition of their continuing in force. With your general contention that patents might contribute even more powerfully than at present to the advancement of science and the useful arts, I cordially agree, but nevertheless I am constrained to think that you have mistaken the remedy.

That a patent has not been worked does not mean that the public gets no advantage from it. It enters into the art as really for the purposes of disclosure of the idea, of barring the way to a future patent, of limiting the claims of future patents, as though it were actually in practice in every workshop in the land. It is thus a stepping-stone to future advances. Again, a patent forfeited for non-user would just as effectually bar the way to another patent for the same invention as though it were in full force, and your suggestion that an unworked patent is sufficiently in the way to hinder material improvements or make it difficult to get proper claims or even claims sufficient actually to protect the new invention, ignores the principles that a prior publication as well as a patent is equally a bar to another patent upon the same subject matter, and so is an expired or invalid patent.

Returning to the remedy proposed, the compulsory working of patents within one, two or three years after they are granted, it must not be forgotten that the requirement cannot be applied to large classes of patents and those for the most important inventions.

A patent for a torpedo boat, a large gun or its projectile, an armor plate, a submarine cable, a railway construction or for the Parsons turbine could not be worked without an expenditure that would ruin most inventors. The Elmore process for recovering gold was worked on a commercial scale only by the expenditure of 50,000 pounds sterling. The Bessemer process was delayed for some time after the invention and could not have been worked for less than a ruinous sum to the inventor.

Only the trifles can be brought before the public by a compulsory requirement for working. Other inventions of importance at first are displaced and superseded by a later invention, as the making of aluminum by the aid of sodium was displaced by the introduction of the electrolytic process, yet to require the owners of the chemical patent to proceed with working on a commercial scale or forfeit their patent altogether would be a manifest injustice, for the patent was nevertheless valuable as a stepping-stone in the art to further inventions in the same direction.

This is not a new proposal, but has been repeatedly before Congresses and Parliaments with the result that the laws of England and the United States, the two greatest manufacturing countries in the world, contain no such provision.

At the Congress of the International Association for the Protection of Industrial Property, held in Vienna in 1897, it was unanimously resolved that it would in future be necessary to give up the principle of compulsory working; and where not altogether given up it has been unanimously agreed, for example, by the International Convention that the working of an invention in one State ought to be the equivalent of working in all; and in the countries of continental Europe adhering to this principle, there is a notable disposition to relax the requirement, and the whole trend of continental opinion is now adverse to compulsory working.

Germany, Switzerland and Italy have entered into an arrangement such that if an invention is worked in any one of these countries it is deemed to be worked in all.

But the fullest discussion arose in England two years ago, when the Manchester Chamber of Commerce, under the stimulus of the analine dye interests, pressed upon the Board of Trade the compulsory working feature as a provision to be inserted in the revised English patent law.

It is well known that England that year adopted the examination system for the grant of patents, and as the revision of her law was thoroughgoing this question of the compulsory working of patents was strongly urged and well considered.

The discussion eliminated many erroneous impressions and compulsory working was not only not adopted, but the body of opinion was strongly against it, and I believe unanimously against it, both in the Board of Trade and in the Parliamentary Committee.

One of the objections to a compulsory working clause in the patent laws is foreshadowed in your editorial—that it is difficult to determine to what extent and in what way a patent must be worked to satisfy the requirements of the law, and the owners of a patent can never know with certainty whether their patent is valid or not after the period for correcting their mistakes in this regard has passed. Men are thus dissuaded from risking capital in the invention on account of a new danger confronting them from this requirement.

Again, the inventor may not have the experience and practical capacity to work his patents even if he has the funds, for some of the most meritorious inventions have been made by people unfamiliar with the art.

The great advantage to a country of having as in America thousands of gifted men at work to improve the arts, machines, processes and compositions of matter which make up the world of the industrial arts is a resource and asset of the country that is too little prized.

Their reward is the exclusive use of their inventions and discoveries for the limited term of seventeen years upon the condition that they will fully disclose to the public all that appertains to them, and that the public may freely use them after the limited term has expired. The wisest policy is to give the patentee the best patent possible under the circumstances of his case divested of every embarrassment to enlisting capital in the undertaking and with every doubt upon his patent removed that the most competent administration of the patent system can remove.

Indeed, a serious complaint against any patent system is the fact that the seal of the government cannot be final as regards the question of novelty and patentability, because no country can tolerate the grant of a patent for what is already in the possession of the public. It must ever remain, therefore, a judicial question whether a patent once issued is in reality for that which is new and patentable or whether it was already within the knowledge of the public by former disclosures or by prior use, and to add this new danger to capital embarking on untried seas is to forbid and not to encourage the evolution and growth of the useful arts.

There are improvements in the issue of patents that are entirely within the scope of immediate useful reform. Both are in the process of development at the present time in our system. The collection and the classification of all material in print relative to the industrial arts is the requirement of the law as it stands, not only in this country, but in others. The practical realization is not yet fully reduced to fact in any country, not even in our own.

Yet great progress has been made and is now making and we may fairly anticipate that in reasonable further time every application for a new invention or discovery will be compared with everything that is in print upon the same subject matter—with the 2,000,000 patents in the aggregate granted in all civilized countries, with the scientific books, with the printed disclosures in the technical press and in other publications, and so grouped and classified that the examiner passing upon the new application as well as the applicant himself may expeditiously turn to that part of this matter which pertains to his invention and make the comparison himself.

It could, therefore, rarely happen that a patent would be wrongfully withheld, but in the absence of a direct interest opposing the patent some would issue that ought not. But with the record showing what was cited against it, the evils pertaining to the issue of invalid patents would be reduced to a minimum.

Second, the requirement of the Patent Office that inventions should be dismembered and split up into numerous applications and finally numerous patents upon related parts of the invention because they are capable of separate use, will ultimately pass away and should pass away.

The Supreme Court of the United States in the recent case of United States ex rel. Steinmetz against the Commissioner of Patents, decided February 23, 1904, cleared away a vast accumulation of error. It was there held that the statute gives the right to join inventions in one application in cases where the inventions are related, and that it cannot be denied by hard and fixed rule which prevents such joinder in all cases.

It may, therefore, be regarded as the settled policy of the law as interpreted by the highest court in the land that the applicant has

rights in this matter of division and may come before the office with all that he has invented at one time concerning the same subject matter, and if the elements are related and co-operate, he may include them in one patent. What harm? None whatsoever. It is the desire of the applicant to have his subject matter in one patent. It is for the benefit of the public that it should be so, thus exhibiting to the world these various elements in their proper relation. The public are also freed from the embarrassment of having one element owned by one interest and another by another and perhaps conflicting interest.

Finally, there is a direct remedy for most of the evils which compulsory working is intended to eliminate, and that is a provision, not found in our law, for compulsory licenses. This has been a feature of the English law and in the revision two years ago simpler, quicker and cheaper procedure was provided to meet all cases where the inventor allowed his patent to slumber, either for justifiable reasons or because the patent had passed into hands that were interested in smothering it.

Any person interested may present a petition to the Board of Trade alleging that the reasonable requirements of the public with respect to a patented invention have not been satisfied and praying for the grant of a compulsory license or in the alternative for the revocation of the patent. If it is proved that the reasonable requirements of the public have not been satisfied, the patentee may be ordered to grant a license, or if the reasonable requirements of the public will not be satisfied by the grant of a license the patent may be revoked after three years from its date, unless the patentee gives satisfactory reasons for his default. And if it is proved that the patent is worked or the patented article is manufactured exclusively or mainly outside of the United Kingdom then also unless the patentee can show that the reasonable requirements of the public have been satisfied, an order will be entered for a compulsory license or for the revocation of the patent.

And the reasonable requirements of the public are defined to be that existing industries or new industries shall not be unfairly prejudiced and that the demand for the patented article is reasonably met.

These are the directions in which improvement may be found—perfect searches upon the question of novelty, a high degree of probability for the validity of the patent once issued, and second, the dangers of mutilation by the issue of several patents at successive times for the same invention, absolutely removed by abandoning the compulsory division of applications except where to grant one patent for the whole subject matter would be invalid by reason of the inclusion of distinct and unrelated subjects of invention.

NEW YORK. JOHN S. SEYMOUR.

Molecular Conductivities.

To the Editors of Electrical World and Engineer:

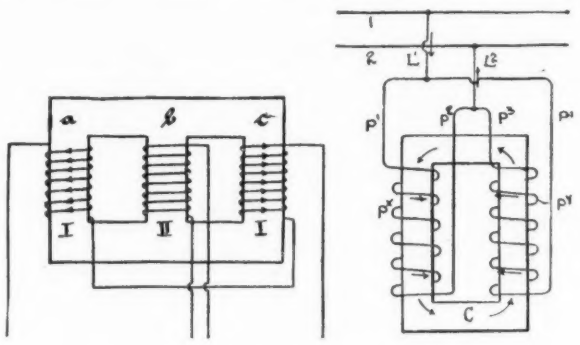
SIRS:—I would like to call your attention to the fact that in your editorial on page 719 of the issue of April 16 you have misquoted and misunderstood my paper on "Molecular Conductivity." If you had carefully read the paper and understood it, you would have found your criticism unnecessary. I was very particular to state exactly what I meant in the paper, which was "that all theoretical deductions based on investigations of molecular conductivities of different degrees of dilution have no physical significance." In your editorial you make me say "all theoretical deductions, based on investigations of molecular conductivities have no physical significance," omitting the very important words which distinguish my statement from yours. If you will take the trouble to examine my statement in connection with the facts, you will find it is absolutely correct.

PHILADELPHIA, PA. C. J. REED.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Transformers.—LOEWY.—In a continuation of his serial on recent progress in the design of electric machines he discusses advances made in transformer construction. Besides various new constructions of the General Electric Company and the Westinghouse Company, the following European designs are described: Fig. 1 shows



FIGS. 1 AND 2.—TRANSFORMER DIAGRAMS.

a three-phase transformer of the Schwarzkopff Company, in which the windings are so arranged that the magnetic circuits produced by the different phases do not influence each other so that an overload in one phase does not react upon the others. The transformer consists of a rectangular iron frame, *a*, with two iron cross-connections, *c*, parallel to the small sides, *b*. Each primary and secondary phase has two windings arranged opposite each other, as shown in the diagram. A similar transformer for two-phase currents, built by the Union Electric Company, is shown in Fig. 2. It has three iron cores, *a*, *b*, *c*. The winding of one phase is placed one-half on *a* and one-half on *c* in such a way that the current flowing through them has either the direction indicated by the arrows or the opposite direction. The winding of the second phase is placed on core *b*. It will be seen that those lines of force which are produced in *a* and *c* by the first phase and pass through the core, *b*, act against each other in *b* so that here only the flux produced by the second phase is effective. In the same way it may be seen that the second phase does not act upon the first phase. A single-phase transformer of the Thomson-Houston Company is shown in Fig. 3 for supplying two separate secondary networks or a secondary three-wire network in such a way that for any load in the secondary network the secondary voltages remain constant. The transformer consists of an iron frame, *C*, on the two long side arms of which the two parts, *Px* and *Py*, of the primary winding are placed. These two parts are in parallel with the circuit, 1, 2, and are so connected that the current flowing through them produces a magnetic flux closed in the iron frame as indicated by the arrows. The two secondary windings are arranged concentrically with the primary windings, *Px* and *Py*. If the load in one of the two secondary windings increases, then this winding will counteract its primary winding with greater force; that is, it will diminish the strength of the magnetic flux so that the counter e.m.f. of the primary windings decreases. For this reason the network will now send more current into this primary winding, so that the strength of the flux, common to the two secondary windings, is maintained. On account of this automatic regulation, the voltage in the secondary windings is maintained constant.—*Zeit. f. Elek.* (Vienna), April 17.

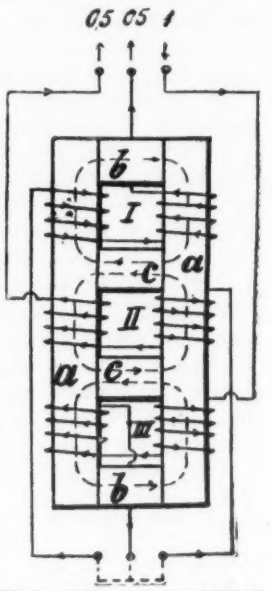


FIG. 3.—WINDING OF SINGLE-PHASE TRANSFORMER.

Electric Resistances of Bearings.—DETTMAR.—A communication referring to the recent letter of Zorawski and the former tests of Kennelly (see page 231, ELECTRICAL WORLD AND ENGINEER, February 7,

1903). He has twice made a series of measurements of the resistance of bearings of electric machines and has always obtained results which did not agree at all with each other. While he tested the friction coefficient of various lubricating oils, he found that this coefficient decreases with increasing speed of the machines, and increases again afterwards. The minimum point of friction corresponds to the moment when a continuous layer of oil has been formed. When the machine is at rest, this layer of oil is broken at the bottom. He tried to determine the same minimum point by resistance measurements, but could not get any consistent results, since the values of the resistances varied greatly. An investigation whether the sort of oil used had any influence did not yield any conclusive results, since no exact relations could be obtained. He sums up his experience in the statement that the electric resistance of the bearing may be very high in operation under special circumstances, but is generally very low.—*Elek. Zeit.*, April 14.

REFERENCES.

Equipotential Connections.—MÜLLER.—The first part of an article in which he says that of the various means for counteracting the formation of sparks at the commutator, so-called equipotential connections have recently attained a greater importance. There are connections between points which should be at equal potential if the symmetry was complete. In case of dissymmetrical distribution of the magnetic field or of a non-uniform load in the different armature circuit, due to non-uniform transition resistances of the brushes, currents will flow in these equipotential connections so that the strain is taken from the brushes and the formation of sparks and overheating is prevented. The author gives a mathematical theory of the calculation of such equipotential connections in a special case.—*Zeit. f. Elek.* (Vienna), April 17.

Diagram of Alternators.—NIETHAMMER.—With reference to Behrend's article on an experimental basis for the theory of the regulation of alternators, the author gives a description of a general three-phase diagram which he has used successfully for determining the regulation and other characteristic properties of the alternating-current machinery made by the Union Electric Company. Since the article consists only of diagrams and formulas it cannot be abstracted. —Lond. *Elec.*, April 15.

Surging of Alternators Connected in Parallel.—SOMMERFELD.—The conclusion of his theoretical article. He gives the integration of his pendulum equation and considers the phenomena of resonance and interference. He then gives a numerical example and finally takes into account those points which he has neglected in his former more approximate calculations.—*Elek. Zeit.*, April 14.

France.—LIOUVILLE.—A statistical article on the import and export of dynamo-electric machines in France in recent years.—*L'Ind. Elec.*, April 10.

LIGHTS AND LIGHTING.

REFERENCE.

Differential Arc Lamp.—VON ZUDNOCHOWSKI.—A mathematical article on the behavior of movable cylindrical iron cores in double solenoids, with applications of the results to the theory of the differential arc lamp.—*Phys. Zeit.*, April 15.

POWER.

Utilization of Peat and Lignite.—WOTHERSPOON.—An account of recent advances, made especially in Germany, in the utilization of the calorific value of peat and lignite. The output in 1902 of briquettes made from lignite in Germany was 12,438,000 metric tons; most of this fuel was consumed in the larger cities of Europe. The wholesale selling price of the briquettes in the larger German cities is between $2.10 and $2.25 per metric ton. The brown coal of Alabama has been briquetted by this process quite successfully and has been declared by the German experts to be superior to the best product from their own mines. It is also stated that remarkable advances have been made in Germany in the manufacture of fuel from peat by means of special mechanical processes. Fuel bricks are clean to handle and practically smokeless and have a calorific value between 8,500 and 10,000 B.T.U. per pound, while the thermal value of American bogs is said to range between 9,000 and 14,000 B.T.U. when bone-dry.—*Eng'ing & Min. Jour.*, April 7.

Electric Lifts for Blast Furnace Plants.—SCHIEBLER.—An illustrated article on electric lifts for blast furnaces. With direct-current supply two motors with series parallel control are now generally used. The motors are compound-wound, the series winding giving a high proportion of the total field, so that at no load the speed is about 75 to 100 per cent. higher than at full load. A capacity of 120 to 140 hp is now often required for lifting ores. The author describes electric lifts built by two German companies. An automatic interrupter is provided for breaking the current at the end of the lift to prevent accidents in case of lack of attendance by the engineer, and this is done by means of a switch which does not interrupt directly the main current, but operates a relay circuit in which a small current flows. The latter passes through the magnet coils of a high-current switch, on the armature of which the high-current contacts are mounted. Since the armature is attracted instantaneously and also drops off instantaneously on account of its weight, switching is instantaneous. The lift for blast furnaces is mostly built with an inclined road, but a vertical lift is also described which is used as reserve. It is operated by a single motor. Since its capacity is 140 hp, the controller does not act directly upon the main current, but regulates small relay currents.—*Stahl und Eisen*, April 15.

REFERENCES.

Turbo-Generator.—An article giving the results of tests of a 900-kw turbo-generator recently installed in a German mine. The steam turbine is built by Brown, Boveri & Co., and is direct-connected to a 325-amp., 2,000-volt, three-phase dynamo with a power factor of 0.8 and a frequency of 50, and to a 110-volt, 105-amp. exciter. The number of revolutions is 1,500—*Glückauf*, April 16.

Mining Locomotive.—PERKINS.—An illustrated article on the development of the electric mining locomotive.—*Sc. Am. Sup.*, April 23, 30.

TRACTION.

High-Speed Railways.—PETERSON.—The first part of an article on the importance of the road construction for high-speed electric railways. The success of the experimental Zossen line of the German Studiengesellschaft has shown that to get a speed of 200 km. per hour with one car, a power consumption of 1,600 hp is sufficient. This shows that the pure cost of current remains within a limit which renders the financial success of such a road possible. However, the idea of sending single cars at short intervals over such a road, appears impossible on account of the prohibitive cost, since the consumption of 1,600 hp for a car of about 100 tons of weight, could not be covered by the receipts from about 80 passengers. If, however, a train of about 5 cars is used, the author estimates that 400 passengers, with a weight of train of about 250 tons, could be carried at a speed of 200 km. per hour with a power consumption of about 2,400 hp. In this case the current per passenger would be only three-tenths of that with single car operation. He thinks it would be preferable to make each car a motor car. In case the length of the train varies it would, then, however, be impossible to maintain the speed of the trains absolutely the same. While Reichel's arrangement of the three trolley wires, one above the other, has been shown to be an engineering success, he considers the great height to be a disadvantage. At street crossings the railway road would have to be carried above the streets. The whole construction of the road would be expensive. The most difficult question is, however, whether the construction of the track will be satisfactory for speeds of 200 km per hour. The results so far obtained on the Zossen road do not allow any decisive answer to this question. The problem is not whether the position of the rails is changed by a relatively small number of high-speed runs, but the real question is whether the road can be maintained continually in satisfactory condition without extravagant expense. He points out that for the Langen suspended railroad (as used in Elberfeld) the claim is made that the road is far superior to ordinary railway roads with regard to safety, to the possible speed and to the cost of maintenance. He estimates that with the ordinary track construction for a speed of 200 km. per hour, the smallest allowable radius of curve of the road would be between 2,500 and 1,600 meters. This seems to make the construction of such a road impossible within built-up districts. For a suspended road this condition does not exist. The article is to be continued.—*Elek. Bahnen.*, April, No. 8.

Storage Battery Traction.—PALLITSCH.—A description of a storage battery car used on the suburban railroads of Dresden, Germany. The car has a capacity for 98 passengers and is provided with a battery of 184 double cells, each double cell having a capacity of 430 amp.-hours at a discharge rate of 140 amp. The average discharge voltage is 365. The cells are charged from a station connected to the Dresden tramway system, by connecting the cells in series, at

an average of 480 volts. In order to charge the cells from a 120-volt circuit, the cells are connected in 4 parallel groups. The car is provided with four 360-volt, 27-hp series motors. The car weighs, without passengers, 44,000 kg. The speed is 45 km. per hour.—*Elek. Bahnen.*, April, No. 8.

REFERENCES.

Far East.—An article on electric railway development in the Far East. In spite of the large population there are now only six electric railways in operation outside of those in Japan. From a financial standpoint, the roads have been satisfactory, although the track mileage is very much smaller than that for cities of similar population in either Europe or America.—*St. R'y Jour.*, April 23.

Single-Phase Trolley.—Detailed descriptions of the method devised by the Oerlikon Company for collecting the current by means of a trolley from an overhead wire at the side of the road, for use on single-phase railways. The method has already been referred to in the Digest.—*Elek. Zeit.*, April 14; *St. R'y Jour.*, April 23.

Adjusting Car Resistances.—GOUGH.—A description of a practical method of adjusting the resistances of a K-10 controller, so that in going from one step to another the differences in the resistances will not be great enough to cause any violent shocks in car movement.—*St. R'y Jour.*, April 23.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

REFERENCE.

Electricity on Board Ship.—LEBOND.—A continuation of his serial. In the present installment he discusses the installation of electric searchlights on battleships.—*L'Ind. Elec.*, April 10.

WIRES, WIRING AND CONDUITS.

Eddy Currents in Cable Sheaths.—FIELD.—The first part of a paper read before the (British) Institute of Electrical Engineers. Single-core cables designed for carrying alternating currents of any magnitude cannot be laid in separate iron pipes, owing to the strong alternating magnetic field which will be created in the mass of the pipe by the current and the hysteresis and eddy current losses consequent thereon. On the other hand, it is considered quite permissible to lay concentric or three-core cables (for three-phase currents) in iron pipes or troughs, for wherever there is included in the same cable both the "go" and the "return" conductors so that at every instant the algebraic sum of the currents within the pipe or trough flowing in either direction is zero, there cannot be any closed magnetic lines entirely surrounding that cable created by the currents within it. However, it would be wrong to believe that there is no external magnetic field produced by a three-phase current in a three-core cable; indeed, a very considerable field may exist giving rise to telephonic disturbances in neighboring circuits, eddy currents in the lead sheath or the iron pipe itself, and even earth currents. Similarly, if the "inner" so-called concentric cable be not truly concentric with the "outer," an external field will result, while if several concentric or three-core cables be connected in parallel at both ends, and for any reason the resistance of one conductor be unduly increased (e. g., through a bad connection), so that the algebraic sum of the currents included in this cable is not zero, not only will an external field exist, but there will be magnetic lines entirely surrounding the cable in question giving rise to losses if laid in an iron pipe. The author considers the external fields produced near single, concentric, three-core cables and the like, and investigates the losses occasioned thereby. In the special case of two lead-sheathed cables whose centers are separated by a distance of 12 in., the mean radius of sheath in each case being 0.587 in., he finds for a frequency of 60 and an effective current of 200 amp. that the mean effective e.m.f. in the sheath in volts per mile will be approximately 73 volts. Taking the cross-section of the sheath as equal to 0.46 sq. in., and the specific resistance of lead at 21 michrom, the sheath current will be 64.5 amp., representing a loss of 4.7 kw per mile length of cable. The paper is to be continued.—Lond. *Elec.*, April 15.

REFERENCES.

Calculating Networks.—MÜLLENDORFF.—The first part of a mathematical article on the rational calculation of distributing networks. The author starts from the case that a consumer is to be connected to one of two stations. In order to get a minimum of copper that station will be selected which is nearest to the consumer. If, however, there are other consumers between the two stations, the choice depends upon certain considerations. The author develops them mathematically and shows that before a distributing network can be calculated it is necessary to choose the position of the central station, and that this position must be taken into consideration when the different consumers are to be assigned to the various feeding points. After the position of the central station has been determined, it is possible to assign to each feeding point a certain district of action, so that all consumers within this district can be supplied more economically from this feeding point than from any other. He gives a method for calculating the network, so that the copper becomes a minimum. The article is to be concluded.—*Elek. Zeit.*, April 14.

Calculating Networks.—VERHÖCKX.—The first part of a highly mathematical article in which the author develops a method for the solution of the series of linear equations, to be solved in the calculation of closed network. It permits to proceed readily as well by analysis as by a purely graphical method. Another advantage claimed for this method is that it gives directly a general solution of the system of equations.—*L'Eclairage Elec.*, April 16.

ELECTRO-PHYSICS AND MAGNETISM.

Magnetic Effect of Electric Convection.—SUTHERLAND.—An article pointing out that by the co-operation of Cremieu and Pender practically the whole of the difficulty in reconciling the apparently contradictory results obtained by various investigators concerning the magnetic effects of electric convection, has been traced to the one fact that Cremieu covered his metallic electrified surfaces with a solid dielectric. A solid dielectric rotating with a charged metallic disc reduces the magnetic effect considerably, so as in some experiments to make it appear to vanish. He refers to some theoretical investigations concerning electrolysis and shows that in ordinary electrostatics the displacement of the ether is not taken into account. It seems that the magnetic effect of electric convection is due to the slip between electricity and ether, and not to the relative motion of electricity and motor ether, although further experiments must be made in this direction.—*Phil. Mag.*, April.

Differential Method of Observing N-Rays.—MACE DE LEPINAY.—A description of a contrast method, by means of which a number of people who could not observe N-ray effects before have now been enabled to confirm them. The method is based upon Blondlot's observation that the impact of N-rays changes the distribution of the radiation from a sulphide screen, increasing it in a direction normal to the surface and diminishing it in a direction tangential to the surface. The author mounts two strips of sulphide close together, one of them being a narrow line 2 mm. thick, and the other a strip 25 cm. long, but inclined at an angle of 1° to the line of vision, so as to appear about the same thickness as the former. The two strips are mounted in such a manner that they appear to form the figure 7, the oblique branch being viewed normally. The strip viewed tangentially is made somewhat more luminous than the other, so that the two strips appear equally bright under normal conditions. If now they are simultaneously exposed to a source of N-rays, such as a sounding body, the strip viewed normally is seen to shine out, while the other darkens, and sometimes disappears altogether. It is possible, and even advantageous, to employ a luminosity much greater than that ordinarily used in N-ray experiments. The surface viewed tangentially must have a very fine grain. The best way of mounting the sulphide powder is to fix it by means of collodion or a rubber solution on a copper plate slightly roughened by an electrolytic deposit. Radiation from one surface to the other must be intercepted by means of a lead screen.—*Comptes Rendus*, March 28; Lond *Elec.*, April 15.

Dielectric Capacity of Atoms.—SUTHERLAND.—A theoretical paper in which he calculates the dielectric capacity of the ions on the basis of a theory formerly developed by him and by means of the mobilities of the ions, determined experimentally by Kohlrausch. He finds the law that the dielectric capacity of an atom is directly proportional to the valency and inversely proportional to the square root of the volume of the atom. The ionic velocity is then directly proportional to the square root of the radius. This explains the old paradox of ionic velocities. Hitherto it has been assumed that the ionic velocities have been measured by the same driving force for all ions. The result that a large ion like that of *K* travels faster than a small one, like that of *Li* under the same driving force in the resisting medium, seems puzzling, until, in taking account of the dielectric capacity of the atom, it is seen that the driving forces assumed equal are in reality not so at all.—*Phil. Mag.*, April.

Disintegration of Platinum Metals at High Temperatures.—HOLBORN AND AUSTIN.—An account of an investigation of the disintegration of platinum metals in different gases. Their results have a prac-

tical bearing on high temperature work in general. Platinum heating coils when brought too near the melting point of the metal are rapidly destroyed, and the case is still worse with iridium, which otherwise on account of its high melting point would be particularly suited for use in producing high temperatures. Some of their results indicate means by which the platinum metals may be protected from disintegration.—*Phil. Mag.*, April.

ELECTRO-CHEMISTRY AND BATTERIES.

Applications of Electricity to Metallurgy.—RICHARDS.—A lecture considering the mechanical, thermal and electrolytic applications of electricity to metallurgy. In the first class are the electromagnetic and electrostatic processes for dressing and concentrating ores. The thermal methods use the electric furnace, the chief features of which are first that heat can be generated up to 3,500° C., which is at least 1,500° higher than can be obtained in fuel-fed furnaces; secondly, the heat is applied internally in such close contact with the material to be heated that the efficiency is much higher than with the ordinary forms of heating. Electric heating will in general cost less if coal costs per ton over one-half of the price paid per electric hp-hour, without considering any other advantages of electric heating. The general principle on which Hall's aluminum process is based, is thought to be applicable for application to the reduction of many other metallic oxides; it is to dissolve the oxide in a solvent which is electrically more stable than the oxide.—*Technology Quarterly*, March.

Manufacture of Iron and Steel in the Electric Furnace.—NEUBURGER.—A review of the process of Stassano, Heroult and Keller. The opinion of Goldschmidt is quoted that the electric manufacture of special steels may compete in Germany with the ordinary method of making crucible steels. Gin is quoted as considering the following arrangement to be of nearly ideal perfection; it is the combination of the ordinary blast furnace for making pig iron, of the Bessemer converter for making the cheaper grades of steel and of an electric furnace for making fine steels, the electrical energy being obtained from generators coupled to gas engines which are operated by the waste gases from the blast furnace.—*Dingler's Polytech. Jour.*, April 2 and 9.

Ozonizer.—ELWORTHY.—A description of his ozonizer, which differs from the Siemens & Halske ozonizer in so far as the low temperature required for getting a sufficient yield of ozone is not produced by water cooling but by passing the air through the ozonizer at a high speed; the air is passed twice through a field of silent discharges. The apparatus is illustrated and the yield of ozone is said to be 60 to 70 grams per kw-hour, the concentration being 0.4 to 0.5 gram of ozone per cubic meter of the mixture of air and ozone.—*Elektrochem. Zeit.*, April.

Primary Cell.—BOUSFIELD.—A Faraday Society paper on a cell which consists of a central porous pot with nitric acid and a carbon pole, and of an outer vessel containing sodium hydrate solution and a metal pole, preferably of zinc. The best results are obtained with nitric acid with maximum conductivity—31 per cent. solution—and a sodium hydrate of maximum conductivity or of a strength slightly below this—a solution from 12 to 50 per cent. The e.m.f. is 2.6 volts at open circuit and as a special advantage of the cell it is claimed that it may be short-circuited far longer than most cells before it runs down. Various other metals, as substitute for zinc, and other acids, as substitutes for nitric acid, were also tested.—Lond. *Elec.*, April 15.

REFERENCES.

Electrolytic Rectifiers.—BURGESS.—A complete reprint of his paper on electrolytic rectifiers for charging storage batteries with alternating currents.—*Sc. Am. Sup.*, April 30.

Non-Aqueous Solutions.—DUTOIT.—A summary of our present knowledge of the electric conductivity, dissociation and other properties of electrolytes in solvents other than water, with an appendix giving a long list of papers on this subject.—*Jour. de Chimie Phys.*, February.

Ozone.—ERLWEIN.—The first part of an illustrated article on the Siemens & Halske system for producing ozone from air by silent discharges and utilizing the ozone for the sterilization of water. The application of the system in connection with German water works is described.—*Sc. Am. Sup.*, April 30.

Primary Cell.—HEINTZ.—An illustrated description of a primary cell in which the depolarizer may be regenerated when it is used up. For this purpose about one-eighth of the depolarizer is removed and a regenerating solution is added. No further details are given except the statement that the electrodes are zinc and carbon.—*Elektrochem. Zeit.*, April.

Determination of Latent Heats of Fusion.—GLASER.—A description of a calorimeter with an electric furnace for determining the specific heats of solid and fluid substances at temperatures up to 1,100° C. The author has used it for measuring the specific heats of lead, zinc, aluminum, copper and tin, and for determining the latent heat of fusion of these metals.—*Metallurgie*, March 22 and April 8.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Localization of Faults on Low-Tension Networks.—GROVES.—An illustrated paper read before the Birmingham Section of the (British) Institute of Electrical Engineers. His remarks refer particularly to a three-wire, low-tension network, with a neutral earthed at the generating station or sub-station through a resistance of two ohms. The more closely a network is "netted" the more troublesome it is to localize faults and from this point of view it is very desirable that each feeder should have its own defined network and be only linked to other similar networks where necessary for balancing and equalizing purposes. He considers it desirable, in addition to the feeder fuses in the station, to fuse at all points where it is found advisable to effect a function between the networks supplied by different feeders, and generally at these points only. The obvious danger of connecting two or more feeders through a distributor without fusing is that in the event of a short-circuit or bad fault, the faulty feeder fuse in the station may blow, and the "short" be fed through a small distributor of sufficient resistance to prevent another heavy feeder fuse from blowing immediately, but carrying enough current to overheat it and destroy it. The fuses at the interconnecting points can be comparatively light, because, if the system is properly arranged, the balancing currents will be small. During summer it is usually no disadvantage to work with many of the linking points

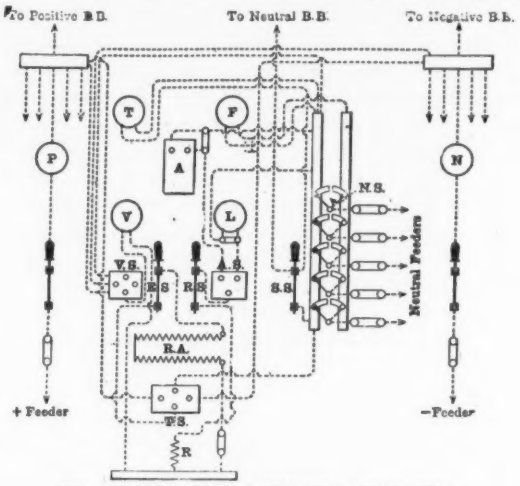


FIG. 4.—DIAGRAM OF TESTING APPARATUS.

open, which provides an excellent opportunity for overhauling the various networks. The neutrals, at points where fuses are inserted on the outers, will, of course be connected up solid. By the use of interchangeable blocks it is possible to fuse any line which may become an object of suspicion. The author describes the following tests which he has found convenient: *a*, observance of reading of recording ammeter permanently connecting the neutral to earth through a low resistance; *b*, join insulation test by Russel's method; *c*, checking polarity of fault by observance of feeder ammeter when "flashed"; *d*, detection of faulty feeder by "flashing"; *e*, partial localization by means of "transferring"; *f*, location by disconnection by shortest length. While these tests fail to indicate the exact position of the fault, final localization may be made by means of an interrupter and induction coil. Various methods of connecting the interrupter are illustrated by diagrams. Concerning Russel's test he says that this is most convenient for a rapid and frequent test. The formula is: $F = (V_2/c) - R$. In Fig. 4 R is the resistance in series with the recording ammeter, A (say 2 ohms), so that the test resolves itself into the reading of c on the ammeter, L, in series with or substituted for A at the time of testing and a momentary opening of the switch, RS, to read V_2 on the voltmeter, V. For moderately high resistances the value of R may be ignored. V should theoretically be of infinite resistance—i. e., electrostatic—but the re-

sults of this test are quite sufficiently accurate if any high-resistance voltmeter is taken. The author has experimented with a combined instrument which, if satisfactory, would replace V and L on the panel. The object of this instrument is to read F directly on an ohm scale when RS is momentarily opened. If the recording ammeter fails to notify any leakage and the test indicates that the insulation is "down," it is fairly safe to assume that the neutral is at fault, although occasionally a balance may occur.—Lond. *Elec.*, April 15.

REFERENCE.

Thermostat.—DARWIN.—A description, with detailed drawings, of an electric thermostat which was designed and first constructed as an adjunct to the spectrograph of the 24-in. refractor of the Royal Observatory at the Cape of Good Hope, the object being to maintain the prisms and other parts as accurately as possible at a constant temperature, day and night, over a considerble period. Two heating coils in oil are provided and a test of resistances is arranged like a Wheatstone bridge. Through its deviation from balance and the consequent deflections of a galvanometer the supply of current for the heating coils is controlled.—*Phil. Mag.*, April.

New Books.

VORLESUNGEN ÜBER TECHNISCHE MECHANIK. By Dr. Aug. Foppl. Leipzig: B. G. Teubner. 471 pages, 176 illustrations. Price, 10 marks.

The fact that the "Vorlesungen über Technische Mechanik" has passed through a complete edition within three years is a strong endorsement of its value. It is the second volume in a series of books upon technical mechanics adopted by the Hochschule in München, and, as its name indicates, is devoted to an exposition of the graphical methods of determining static strains. There are two methods adopted in works upon this subject. One deals with the matter entirely from the theoretical standpoint, which assumes forces acting upon bodies which may or may not, as the case may be, correspond to those which are met with in practice. The other method consists in taking existing structures and analyzing them to determine the relation between the forces and the structures.

Naturally, the present volume has adopted, according to the German fashion, the first method. It discusses at length the various theorems of the stresses produced in theoretical bodies by the application of hypothetic forces, and deals very little with the actual practice as encountered by the engineer in his every-day experience. To some this may appear something of a defect, but on the other hand the volume is replete with theoretical research. It contains numerous well-selected diagrams, which, if carefully analyzed and judiciously applied, will be a material aid to the engineer. As its name indicates, little symbolic analysis is used, but graphical methods are employed for everything so far as it is possible. Considerable attention has been given to the stresses in domes and similar roof structures, and an interesting graphical analysis is given of the stresses in an ordinary railway rail. Cranes and hoisting structures come in for a share of attention, but one misses many of the familiar bridge designs which are often seen in this country. Presumably the reader is expected to extend the principles of the analyses given, to structures which do not receive specific illustrations.

STEAM BOILERS, THEIR THEORY AND DESIGN. By H. De B. Parsons. New York: Longmans, Green & Co. 375 pages, 155 illustrations.

In the preface to "Steam Boilers," Mr. Parsons states that it would be "almost impossible to write a work on the subject which could be considered original." In so far as the exhibition of data, which is new and unfamiliar, is concerned, the author is probably correct, but he has certainly produced a volume which is decidedly different from, and in many respects can make claim to originality over, previous text-books upon the subject. The preface further states that the volume comprises in book form a series of lectures delivered to the Senior Class of the Rensselaer Polytechnic Institute, and the students are certainly to be congratulated upon having their intellectual aliment present in so compact and consise a form, for it is rare to find a scientific text-book in which there is so little that is superfluous. In some respects there is apparently too much condensation, for unless one is prepared either by the perusal of previous treatises upon boilers, or has had considerable practical experience in steam engineering, there is much that might be incomprehensible.

The four opening chapters deal respectively with the physical properties of matter, such as the differences between liquids and gases, and the equations which govern the changes produced in a gas by variation of temperature and pressure; the laws of combustion and quantity of air supply, a classification and description of fuels, solid, liquid and gaseous; and the efficiency of furnaces.

Next comes a general chapter upon steam boilers, which in Chapter VI is succeeded by some pages upon chimney draught, which, apparently, would have been more logically located directly after the description of furnaces. Chapter VII detals with the materials used in boilers, describing and giving specifications for the various irons and steels which are employed.

Chapters VIII and IX take up boiler construction and are replete with matter of value to the designer and the draughtsman, but are almost too technical for a college text-book, excepting for those who intend to make a specialty of steam engineering. In Chapter X mechanical stokers are dealt with, but in an exceedingly brief and cursory manner, so much so as to hardly convey a fair idea of the value of mechanical appliances in firing.

The succeeding portion of the book is chiefly devoted to operation, discussing the questions of scale, corrosion and the testing and care of boilers. Chapters XIV and XV deal respectively with chimney design and smoke prevention, and apparently should have been included in Chapter VI upon chimney draught.

The typography of the volume is excellent; the illustrations are thoughtfully and carefully chosen, largely from actual working drawings, and include much practical information. The volume will take high rank as a brief epitome of modern boiler practice.

LUFTVERUNREINIGUNG UND VENTILATION. By Dr. Josef Rambousek. Liepzig: A. Hartleben. 244 pages, 48 illustrations. Price, 7 marks 50 pfennigs.

A somewhat free translation of the title of this pamphlet would be "Impure Air and Ventilation," and the author attempts to deal with the subject both pathologically and from the engineering standpoint.

The first 95 pages take up the theory of ventilation, showing some of the apparatus and machinery wherewith ventilation may be accomplished and the amount of air supply measured. In some cases, particularly when the author applies calculus to determine the amount of air pollution, the treatment appears to be a little forced.

In the next section the physiological effects of impure air are given considerable attention. Here mathematics are discarded and the work is purely descriptive. Finally, the last third of the pamphlet is devoted particularly to the description of the methods and appliances to be employed in ventilating factories and buildings in which there are many employees and wherein the avocations are such as to be particularly contaminative to the atmosphere, as for example such operations as matchmaking, the production of ammonia, the manufacture of nitroglycerine, and such of the textile arts as are likely to fill the atmosphere with lint or other organic particles.

The subject of air filtration is taken up and the various forms of screens and other methods discussed, although there appears to be no mention of the American device of washing air to effect purification.

As American literature is not overburdened with text-books and descriptions of ventilating appliances, this German exhibition will not encounter an overcrowded market and will, therefore be welcome.

GRUNDRISS DER REINEN UND ANGEWANDTEN ELEKTROCHEMIE. By P. Ferchland. Halle: Wilhelm Knapp. 271 pages, 59 illustrations. Price, 5 marks.

Of the 266 pages of the text, 234 are devoted to the discussion of electrochemical theory, and it may be said that here the author has taken great pains to be exact. He first discusses the theory of electrolysis. After some general remarks on electrolytic conduction, the author gives the laws of Faraday, the determination of the transport numbers of Hittorf, and the principles of conductivity. After a brief review of the theories of Grotthus, Clausius and Arrhenius he passes to the discussion of the relations between the theory of electrolytic dissociation, the gas laws and the modern theory of solutions. He gives the method for calculating the degree of ionization from conductivity measurements, and finally gives Kohlrausch's law for the mobilities of ions.

The author then deals with the changes of energy in electrolytic processes He gives Thomson's rule and the Gibbs-Helmholtz equa-

tion for calculating the e.m.f. of an electrochemical process, and passes to Nernst's osmotic theory of electrolysis. Chapters on measurements of absolute potentials, on the electromotive behavior of non-metals, and on polarization conclude this part.

It must be acknowledged that these first parts of the book should be useful for the introduction into theoretical electrochemistry, since the author has taken care to state the theory exactly and fully, even in its most elementary parts, and to refrain from loose statements—which cannot be said about all elementary books on electrochemical theory. In a later edition the author would do good in adding references on the original papers since such notes on the literature of the subject would render his work valuable as a reference book. The arrangement of the theoretical part is logical, and after one has read the book over it is not difficult to find something in it.

The part on industrial electrochemistry comprises 30 pages, of which 13 are devoted to furnace processes, 11 to electrolytic processes and 5 to the generation of electrical from chemical energy. Even in these pages the author deals more with questions of theory, and the description of industrial electrochemical accomplishments is entirely inadequate. In a later edition the author should either leave out this part altogether or re-write it entirely and attempt to be complete up to a definite point.

Phénomènes Fondamentaux et Principales Applicatiöns du Courant Alternatif (Fundamental Phenomena and Principal Applications of Alternating Currents). By R. Swyngedauw. Paris: Dunod. 1904. Paper, 173 pages, 62 illustrations.

This is an elementary text-book of alternating-current principles. It is clearly and systematically written, but is intended for advanced students, since it employs algebra and elementary calculus.

The book is divided into an introduction and four parts, comprising nineteen chapters in all. The type is good, but the cuts are inferior. In some respects the book is well up to date, as, for example, in respect to the Cooper Hewitt converter; but in some other matters the treatment is archaic and very elementary.

Elektromechanische Konstruktionselemente. By Dr. G. Klingenberg. Blatt 1-30, Apparate; Blatt 51-60, Maschinen. Berlin: Julius Springer. 36 tables, 114 illustrations. Price per installment, 2.40 marks.

This work will be completed in ten parts, of which Sections 1, 2, 3 and 6 are now issued. Upon the completion of the series, the author proposes to publish occasional supplementary numbers, as they are needed to maintain the series in harmony with advancement in design and construction. Each section consists of ten plates, 8 x 13 inches in size, with an index; the plates are unbound and contained in a convenient folder and envelope.

This publication presents a series of sketches which propose to the student and designing engineer the details of the elements of electrical design and construction. Unquestionably this series will meet the needs and desires of a large number of students and engineers. In masonry, steel construction and work of such character plates of this description have long been available; and recently hand-books for machine design have covered the same ground in their appropriate lines. In electrical construction there are yet difficulties in the way of the presentation of an adequate work of examples of design, from which the older lines of engineering are now free. There is still an absence of universality in electrical design, and much of modern construction is still hampered by the idiosyncrasy of the manufacturer.

Prof. Klingenberg has selected his examples from thirteen of the more prominent German manufacturers. It is a matter of surprise, in this connection, that these firms have been sufficiently broad and progressive to have permitted the use of their designs and drawings for general circulation. From this very cause, however, the work suffers its most marked limitation; the sketches are reproduced from assembly drawings; for the most part each device is given in elevation and plan, and there are few sections and details shown. While the drawings are dimensioned to a limited extent, the essential dimensions which student and designer alike would desire are not given—evidently for commercial reasons.

The series covers the entire field of approved electrical design. The selection of examples is judicious and fully representative. The plates are of a convenient size for use and are printed and reproduced with remarkable sharpness of line. They are, perhaps, too crowded in appearance, and their usefulness would have been enhanced had fewer sketches been placed on the plate, and these had been more intelligently arranged.

The series as a whole is an important contribution to the literature of electrotechnics, and will be useful to a large class of readers. It is to be hoped that it will suggest a similar work covering American practice.

Climax Arc Lamps.

A new form of enclosed arc lamp herewith illustrated and described has been brought out under the name of "Climax" by the Keystone Electric & Manufacturing Company, Allegheny, Pa. The cuts, Figs. 1, 2 and 3, show it complete and in detail. A special feature shown in Fig. 1 is the regulating coil made by machinery designed for the purpose. A flat copper strip is wound spirally about a solid mica core and each layer of the spiral is separated from the adjacent layer by mica washers. The spiral is then surrounded by another mica tube, and all is encased in a metal tube, with metal heads, to which are fastened the necessary terminals and a clamping device to adjust the coil with. The whole forms a solid indestructible fire-proof coil. Fig. 2 is a view of the mechanical movement of the lamp, with the dash-pot and the flat spiral connectors, the latter being regarded as a decided advance in current-carrying devices for such work.

FIG. 1.—REGULATING COIL.

The upper carbon holder and the carbon-carrying tube have but one motion and cannot be turned, avoiding disarrangement of the spiral conductor during operation. In the direct-current lamp the dash-pot is constituted with a loose-fitting piston of large diameter in the gas diffusing chamber. This piston is fastened to the clutch plate in such a manner as to have a lateral motion, thus permitting it to find its own free path and avoiding all possibility of wear and sticking, due to friction.

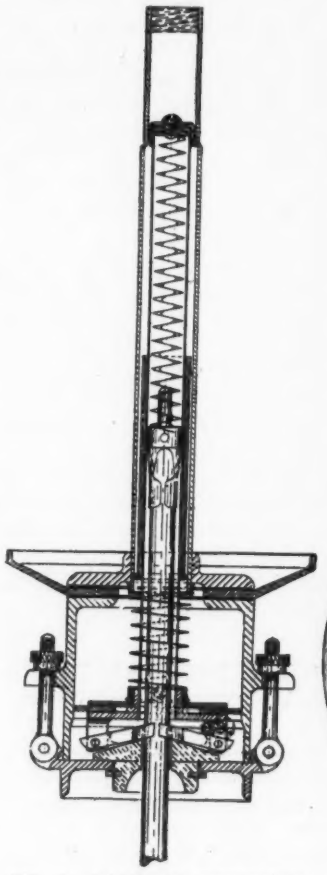


FIG. 2.—DASH-POT MOVEMENT.

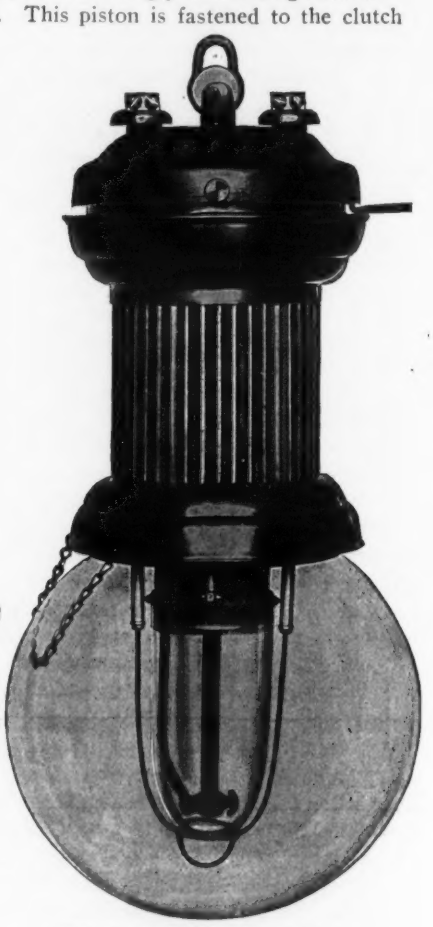


FIG. 3.—ENCLOSED ARC LAMP.

The enclosing globe cap forms the bottom of the gas-diffusing chamber and dash-pot, and carries the indestructible insulating bushing and negative carbon support. It is held in place by two outwardly-swinging arms engaged by two lugs on opposite sides of the gas chamber, and fastened by thumb nuts. This feature in connection with the sealed tube in which the armature operates furnishes

a perfect enclosure with resultant long burning of 200 hours. The clutch is composed of two cast-iron parts—duplicates—hung on two cotter pins in such a manner that when they fall toward each other the opening becomes less than the diameter of the carbon. Hence, when the clutch plate is raised they grip the carbon securely.

The porcelain resistance holder has a thread moulded on its outer surface, in which the wire is carefully wound. A special clamping device is placed to one side with a sliding member, by which the adjustment for proper arc voltage is achieved. The company will also furnish an external resistance, in a separate case, for 220 to 250-volt lamps, which may be placed at any convenient point; or the lamp may be suspended from it. A switch is provided in the top of the lamp to cut it out of circuit when burning; and will be found to do its work effectively, breaking 250-volt circuit, without any perceptible arc.

The housing, with its colonial design, has a pleasing appearance. It is made of copper and riveted, no solder being used on any part of the lamp. The outside globe holder is fitted to an internal sleeve of the main shell by three bayonet locks, and is easily removed or replaced. Housings of steel or brass can be furnished, if so desired. The inner globe is of large diameter, allowing the whole hand to enter for cleaning. It is of the closed end type, and is readily removed and replaced, when trimming.

1,500-K. W. Alternator for St. Louis.

Following is a description of a National alternating-current generator to be installed at the central power station at St. Louis. This alternator will be direct-connected to a 2,250-hp Hamilton Corliss vertical cross-compound engine. The rated output is 1,500 kw, 25 cycles, 6,600 volts, running at 83 r.p.m., and the current generated will be used for various purposes.

Like all standard alternators built by the National Electric Company, it is of the revolving field type, thus leaving the armature stationary and easily accessible, and the difficulty of properly insulating the armature coils is eliminated as the windings are not subject to any mechanical strains whatever. The revolving field is of large diameter, giving additional fly-wheel effect to the engine, and the construction of the field coils makes them practically indestructible. All parts are accessible and the method of ventilation insures low temperatures.

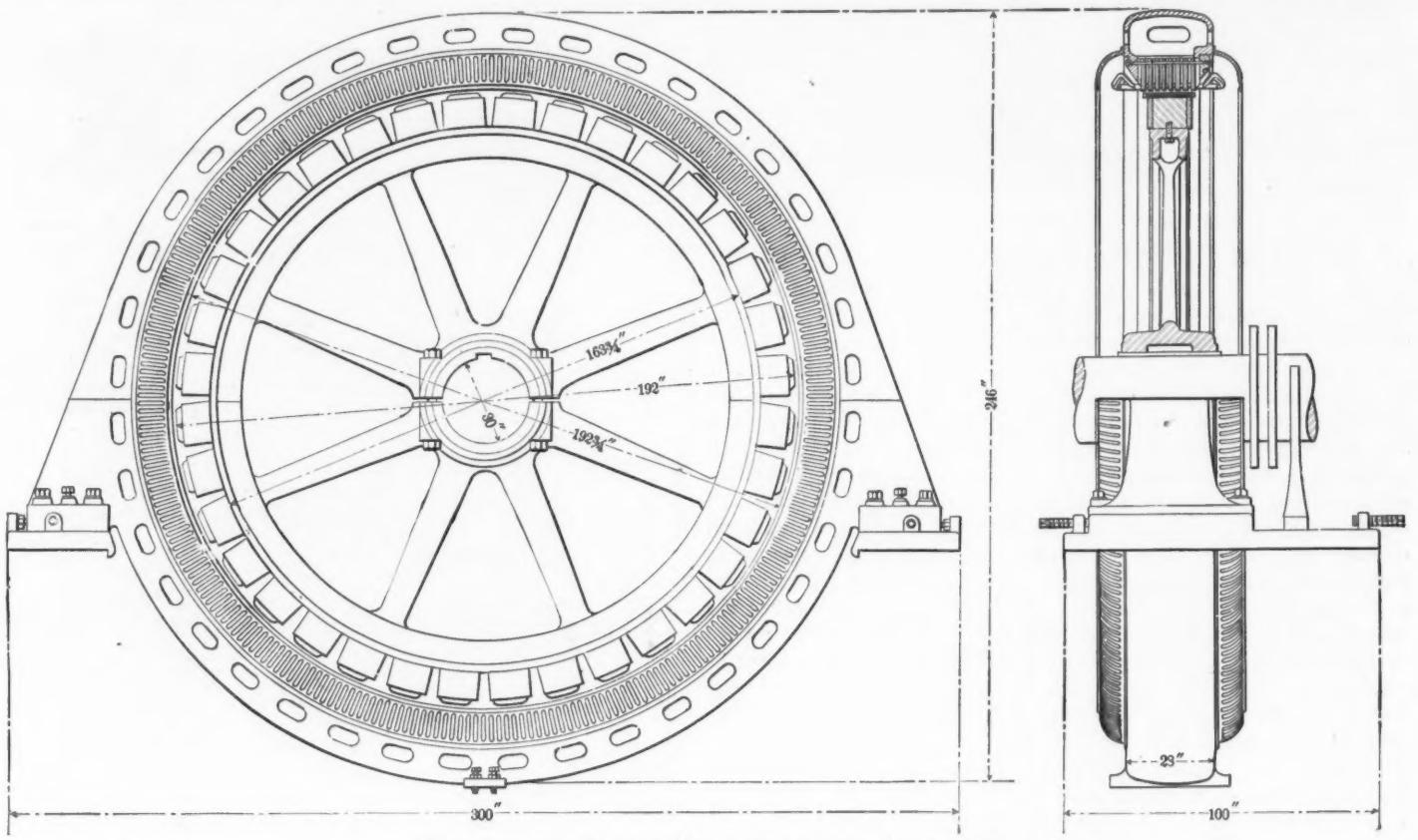
The revolving field is made up of cast steel in halves, which are bolted and secured together by shrunk links. The rim of the wheel is of channel cross-section to which the cast-steel pole pieces are bolted. The field coils comprise 65 turns of 1½ x ⅛-in. copper strap, wound on edge and thoroughly insulated, the outer edge of the coil being exposed to the atmosphere for cooling. Laminated pole shoes are secured to the ends of the pole pieces and serve to hold the field coils in position. These shoes cover a large polar arc, distributing the magnetic flux evenly.

The field coils are insulated from the pole pieces by fuller board, and from the pole shoes and spider ring by heavy fibre. The revolving field is 16 in. in diameter and weighs approximately 50,000 pounds.

The frame is a circular cast-iron housing into which laminated punchings with inwardly projecting teeth are assembled, for the reception of the armature windings. The frame is extremely heavy and stiff, not requiring any external support, and is divided horizontally, the halves being firmly bolted and keyed together. Bolts and keys are contained entirely within the cross-section, obviating the use of side lugs. Large open spaces are provided in the sides of the frames, allowing a free passage of air from the ventilating ducts in the core.

The armature core is built up of laminated soft steel punchings, being annealed and japanned before assembling; ventilating space blocks are inserted at suitable intervals, providing openings extending around the circumference and allowing a free passage for the heat generated in the windings. There are six slots per pole, 2½ in. deep by 1½ in. wide, each being wound with 14 conductors of .37 by .28-in. compressed copper strand. The external diameter of the armature is 16 ft. ¾ in. and the width of the core 16 in.

Cast-iron collector rings and carbon brushes are used, enabling the machine to be operated with a minimum amount of attention and at the same time providing a collector gear which will carry a heavy temporary overload.



ELEVATION AND SECTION VIEWS OF 1,500-KW ALTERNATOR.

The net weight of this alternator is 135,000 pounds, and following are the guarantees on this machine:

Efficiency—1¼ load, 95.5; full load, 95.5; one-half load, 94.75. Regulation—0.5 per cent. on power factor, 1; 22 per cent. on power factor, zero. The temperature will not exceed 30° on the armature and magnets on a continuous run at full load and 40° on the armature and magnets on a continuous run at 25 per cent. overload. This generator has been built by the National Electric Company, at their Milwaukee (Wis.) shops.

A Circumferential Velocity Indicator.

We illustrate herewith an interesting speed indicator, known as the "Cut-Meter," and manufactured by the Warner Instrument Company, Beloit, Mich., which is particularly useful in determining cutting speeds in machine tool work. The radical feature is that instead of being actuated by gearing there is an Arago disc arrangement whereby a revolving magnet imparts a torque to a disc connected to the indicating dial pointer. The instrument is a combination of a tachometer and a wheel, the calibration being such that every foot traveled by the circumference of a wheel bearing on the revolving surface, the circumferential speed of which is to be determined, registers one foot upon the dial. If the wheel is 6 in. in

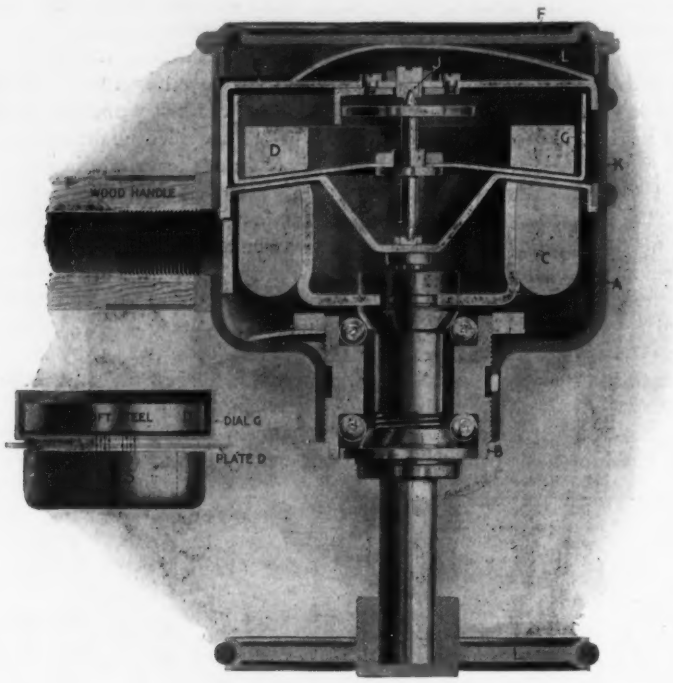


FIG. 1.—SECTIONAL VIEW OF CUT-METER.

circumference, for example, two revolutions of the tachometer shaft will be required to indicate one foot on the dial, so that it is only necessary to properly calibrate the instrument in order to get a direct reading in feet per minute.

Referring to the accompanying illustration, Fig. 1, the magnet, *c*, is carried by the ball bearing, *b*. The outside is threaded and screws into the outer case, *a*. The ball bearing is secured by a spring washer and is finally adjusted at the factory. In front of the magnet is a soft steel ring, *d*, which deflects the lines of force through the aluminum disc, *g*. This disc is mounted on a hardened steel shaft and supported by the jewels, *j*. On the outside edge of the aluminum disc are engraved the fingers indicating the speed. Also attached to this shaft is a hair spring, *h*, so adjusted that it resists the turning of the aluminum dial and brings it back to the zero point when the magnet is at rest. The jewel bearings and the steel ring are carried by the inner case, *e*, which telescopes into the outer case and can be removed at will. The inner case also serves the purpose of protecting the dial, *g*, from the air currents set up by the magnet when revolving. Through both outer and inner case is an opening covered by a glass, *k*, through which the figures on the aluminum dial can be read. Attached to the main shaft is the driving wheel or disc, *i*, of proper diameter, having a grooved periphery, into which is snapped a miniature rubber tire, *m*.

Fig. 1 illustrates the arrangement of the poles on the permanent magnet. The lines of force flow from the north pole through the aluminum dial, *g*, to the steel plate and back again through the dial to the south pole of the magnet, *c*. When the magnet is revolved it sets up a dragging or accessory action in the dial, *g*, this action or rotation being in proportion to the speed of the magnet; and as the hair spring is subject to the same law, it is evident that increasing the speed of the magnet will increase the displacement of the dial in exact proportion. The dial or scale can, therefore, be marked by equal divisions from the lowest to the highest reading. Since adjusting the magnet closer to the steel ring increases the torque or dragging effect, it is only necessary to select a hair spring of proper stiffness, to revolve the magnet at a known speed, at the same time adjusting the ball bearing until the scale indicates the correct speed. The instrument will then be accurate on the entire range of the scale and will remain so permanently, there being no necessity for subsequent adjustment or recalibration.

As there are no mechanical connections between the magnet and the indicating dial, and as the magnet runs very easily (there being always an abundance of power to drive it), there can be no inaccuracy up to this point.

The indicating dial is mounted on a steel shaft, the points of which are hardened and supported in sapphire jewels, practically eliminating all friction or retardation. How perfectly this is accomplished can be judged from the fact that a change in speed of one-fifth of 1 per cent. is shown on the dial. Since the dial and shaft are very light, the strength of the jewels and pivot is great in comparison to the weight, and experience has shown that they will stand indefinitely the regular service likely to be given in any ordinary machine shop.

Fig. 3 shows a "cut-meter" complete, full size. The instrument is sufficiently small and light, so that it can be carried in the pocket without inconvenience. It presents a very handsome appearance, being substantially constructed of brass and nickel-plated. The handle is turned from a hard tropical wood and is highly polished.

The material of the ball bearings is a superior quality of soft steel, which is first finished to shape and then case-hardened. Each

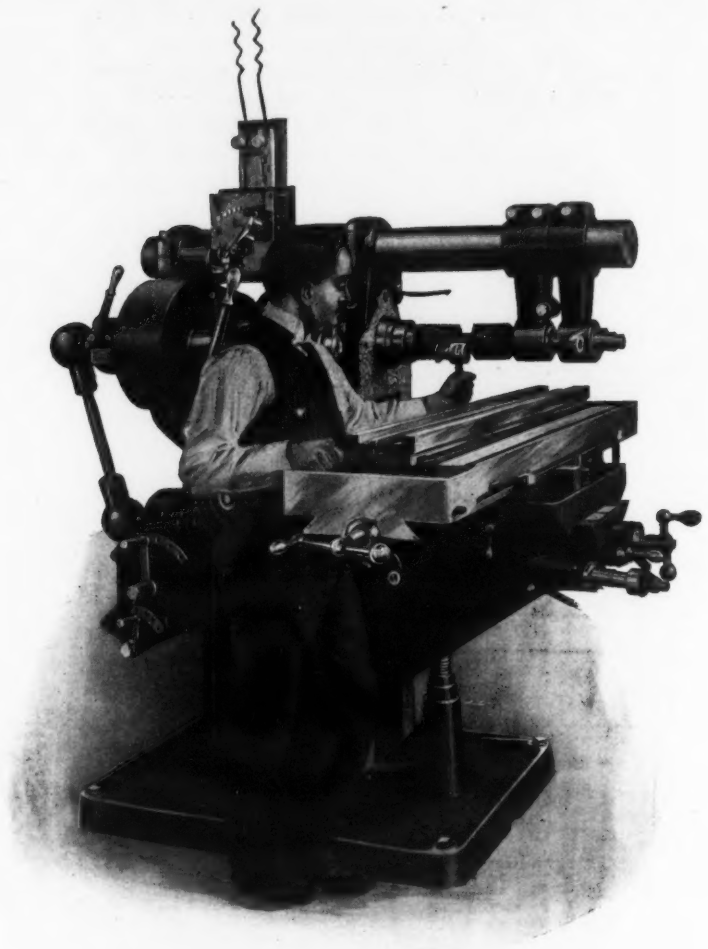


FIG. 2.—THE CUT-METER IN USE.

piece is ground on a specially-constructed machine, so that every part may be true and in perfect alignment. After being ground, each part is carefully tested, and imperfect or soft pieces discarded.

Fig. 1 shows the details of bearings. In a test several of the bearings were run at a speed of 15,000 r.p.m. for a sufficient length of time to equal several years actual work on the instrument; at the end of this crucial test, the bearings were found to be in as perfect condition as before.

The magnet is practically permanent under all conditions. The air-gap is only about 1/32 of an inch, or about one-half of 1 per cent. of the entire length of the magnet. This narrow air-gap effectually prevents the instrument from being influenced by outside magnetic

forces, and the strongest field does not affect its accuracy in the slightest degree. The steel used is of a special quality and is made to order. The pieces are first hardened, then magnetized, and then aged by a process which prevents further change in strength. They are carefully tested and laid aside for a considerable interval before being retested. This test is so delicate that a change too slight to be appreciable in actual work is at once detected.

This meter is of particular value to the machine shop manager, for by its use he will probably find in a large majority of tests made that the working speeds in his shop are from 25 to 50 per cent. lower than they ought to be in order to obtain the most profitable results. In a factory recently inspected, equipped with a multi-voltage drive, one tool was found running on soft steel at a speed of 150 ft. per minute, while the average speed throughout the entire factory on the same stock was about 24 ft. On another occasion, of two boring mills inspected of the same make working on the same stock, the speed of one mill was 150 ft. and the other 22 ft., the cut

FIG. 3.—CUT-METER, FULL SIZE.

and feed being practically the same in both cases. With the use of an apparatus such as that described there is no guesswork, since it indicates the cutting speed instantly, accurately and with a dead-beat register. The meter is available for a number of other uses besides determining the cutting speed of machine tools. When held on the outside of a paper mill dryer it instantly indicates the exact speed at which the machine is making paper. It can also be applied for determining the speed of elevators, since it is not necessary with it to make any calculations, and at the same time indicates when the elevator car is traveling at its maximum speed.

Screwless Electrical Fixtures.

A novel departure in the method of connecting wires to appliances has been made in the "Noscru" midget push button, manufactured by the Sarco Company, No. 906 Sixth Avenue, New York City. The circuit wires are simply threaded through the rubber bottom of the button, bent over, and by one twist the button is ready to set in position. A yielding plunger of phosphor-bronze makes a direct wiping contact on the wires, thus obviating the necessity of using screws, clips or other fastenings; and it takes less than ten seconds to connect the button, without the use of tools. The illustration readily explains the method to the practical electrician.

SCREWLESS PUSH BUTTON.

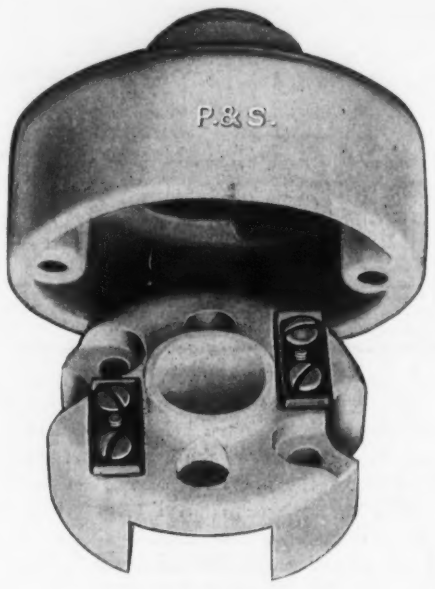
One of the chief features of the Noscru button is that it can be taken apart by bending the two pins at the bottom in a vertical position and the inside part falls out. It can be engraved or stamped and inserted again and made fast by two ordinary pins.

The Noscru midget push is made in standard sizes, while the Pee-Wee takes a No. 18 wire, and yet is really the smallest button in the world. The "Pee-Wee" fits a 3/16-in. hole, and can, therefore, be used in many places to a greater advantage than anything else of its kind on the market. The Noscru button has the contact concealed in the rubber body and therefore is readily adaptable for any kind of exposed work, such as outside door plates, marine work, etc.

The makers inform us that they have had the Noscru button under a perfect test for three years, and that it has never failed to work. The Sarco Company promise a Noscru key arm switch in a few weeks which will have the same advantages in itself as the Noscru button, for the purposes for which it is intended.

Fuseless Rosette for Concealed Work.

We illustrate herewith a new fuseless rosette for concealed work, which has just been placed on the market by Pass & Seymour, Inc., at Solvay, N. Y. It embodies a number of neat features. The bot-



FUSELESS ROSETTE.

tom of the base is recessed to permit the heads of tubes to extend half an inch from the ceiling, and it covers them up completely. A closed porcelain cover then slips over the whole, with perfect concealment, making a very finished and complete installation. The material used is of the high grade with which the manufacturers' name has so long been associated, while the finish and smoothness of the rosette are in every way admirable. The trade is supplied with this device from headquarters or from the various branch offices.

New Form of Fuse.

A new fuse that has just been introduced by the Horton-Massnick Company, of Detroit, Mich., is herewith illustrated. The fuse is especially for set-screw contacts with centers which engineering practice has established. Both terminals are flexible and will take any centers from 1⅜ in. to 3 in. The fusing material is formed in the shape of the letter U and is entirely surrounded by finely divided refractory material, with the exception of a very short portion, which

NEW FUSE.

is exposed to view through a hole in the bottom of a brass cap, which seals the open end of the fuse case or tube.

The hole in the brass cap is covered by a transparent disc and the fuse is so constructed that the fusing material will blow exactly under this window. The user can determine at a glance whether or not the fuse is blown, because he can see the fusing material itself or the blackened window resulting from the blown fuse. The fuse is designed for 250-volt work and can be furnished in capacities from 1 to 30 amp.

A New Testing Set.

Machado & Roller, the selling agents of the Whitney Electrical Instrument Company, are marketing a new form of testing set, illustrated in Figs. 1 and 2 herewith. It is of the decade pattern, in which the drawbacks incident to the great number of plugs necessitated by the old post-office form of construction are eliminated, there being but four plugs in the rheostat itself. It will be noticed that

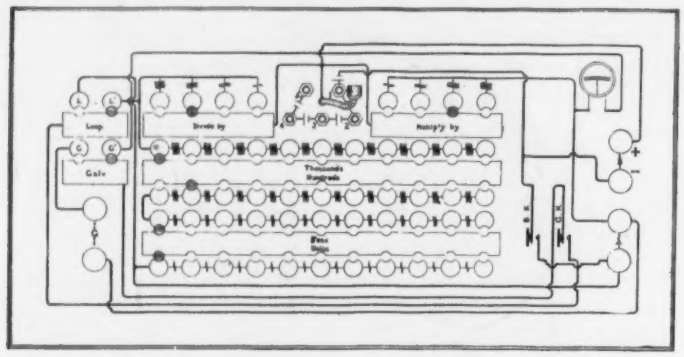


FIG. 1.—DIAGRAM OF CONNECTIONS.

the use of reversing blocks in the bridge arms has been done away with by adding an extra coil to each arm. This expedient eliminates two plugs and makes the operation of the set much more easy to understand. The keys are of a novel form which can be operated independently or like the conventional combination key, whichever is desired. Five large dry cells are built into the containing case and a flexible cord with plug is arranged so that any number of them can

FIG. 2.—GENERAL VIEW OF TESTING SET.

be used at will. An ingenious modification of the ordinary construction of decade and post-office sets is used to shift the internal connections from those employed in making ordinary resistance measurements and the Murray test to the connections for the Varley test, so that the two "X" posts common to every bridge are the ones to which the outside line is always attached no matter what test is being made thereon. A pair of binding posts to which an external galvanometer of the reflecting form may be attached for high sensibility work is also provided; and by shifting one plug, either this external galvanometer or the one that is built into the set is brought into play. Another pair of posts allows of the use of an external source of e.m.f. where this is desired. Instead of following the conventional procedure of marking the ratio arm blocks "A" and "B," they are stamped "Divide by" and "Multiply by," respectively. The connections are such that, when a plug is inserted in the gap between the "divide by" block and any one of the four circular blocks opposite thereto, the readings as indicated by the position of the plugs in the rheostat are to be divided by the number stamped on the circular block to get the correct reading. Similarly, the resistance plugged in the rheostat is to be multiplied by the number indicated by the position of the plug in the "multiply by" ratio arm block. The plug blocks for changing over the loop and galvanometer connections are marked with similar clearness, so that practically any one can use the bridge without chance of confusion. The actual diagram of connections is as shown by Fig. 1.

An accuracy of adjustment of a tenth of one per cent. throughout is claimed, and it is also stated that the galvanometer is sufficiently sensitive to give a marked deflection with a tenth of a per cent. resistance variation when working with full battery power on a resistance of moderate value. The galvanometer is not affected by external fields and can be used with the set in any position. It is thought that a moderate-priced set having the above characteristics will meet with considerable favor from a large class of users.

Sheet Metal Stamping Press.

A machine tool of large utility in the electrical field is the sheet metal stamping press, and we illustrate herewith the 1904 type brought out recently by the Perkins Machine Company, of South Boston, Mass. It weighs 1,275 pounds, is made with jigs throughout, and has each part interchangeable. The shaft is of large diameter and supported by large bearings bored out from the press body. The clutch is of special design, giving a high rate of speed, from 50 to 300 revolutions. There are three shelves which can be detached from the machine. One shelf is for the screw driver, oil can, wrenches, etc. The other shelves are to receive tin, one before stamping, and after stamping the scrap is thrown on the other shelf. This makes the

STAMPING PRESS.

press fire-proof, and does away with the combustible boxes and other matter that accumulates under the press, inasmuch as every manufacturer who uses a press is obliged to have a table of some kind to put the scrap on.

The Perkins Machine Company makes over 200 varieties of press, from those for light jewelry work to presses that stamp out battleship plates. The hermetically-sealed steel caskets are made on them, as well as the well-known Oneida steel pulley. The parts for the Edison storage battery are made on these presses, and even the small mica washers so familiar in electrical goods are made in quantities on Perkins presses in North Carolina.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Dullness prevailed in the stock market and speculation was quiet, there being an absence of outside interest. Unfavorable railroad earnings, the quietness of trade and uncertainty regarding crop prospects, with the unsettled situation in the Northern Securities matter, all contributed to this end. Money was exceptionally easy; in fact, it was a drug on the market and prices for it were low. During the week Metropolitan Street Railway placed a loan for $2,500,000 on short-term notes at 5 per cent. There was no movement of any consequence in the standard stocks, but in the Steel shares there was some activity, preferred receding somewhat on the pessimistic reports as to iron and steel trade. In industrials nothing of a noteworthy character occurred excepting the rise in gas stocks, although Rubber preferred held its own on the resumption of dividends. The curb market dwindled to small proportions, and was without feature except for a rise of nearly 20 points in Brooklyn Union Gas 6 per cent. convertible bonds on sales of $120,000. Some of the copper stocks are a little higher, and Interborough Railway advanced over 2 points. Electric and traction stocks are all lower than a week ago, the greatest decline being 4¾ in General Electric, Allis-Chalmers preferred and Westinghouse common following with 3 points each. All three of these stocks closed at the lowest prices of the week for each, namely, General Electric, 159¾; Allis-Chalmers 40 and Westinghouse 155. While the tractions were weak they did not lose quite so heavily as the electric stocks above named, although they too closed at the lowest figures. Brooklyn Rapid Transit closed at 46¼, being a net loss of 1¼, and Metropolitan Street Railway 112¼, a net loss of 1⅞. Following are the closing quotations of May 3:

NEW YORK.

	Apl. 26	May 5		Apl. 26	May 5
Allis-Chalmers Co.	6¼	6¼	Electric Vehicle	5	5¾
Allis-Chalmers Co. pfd.	39	39	Electric Vehicle pfd.	8	9
American Tel. & Cable	86	86	General Electric	161	157½
American Tel. & Tel.	126	126	Hudson River Tel.	..	..
American Dist. Tel	23	23	Metropolitan St. Ry.	113	109¾
Brooklyn Rapid Transit	46¼	45⅝	N. Y. & N. J. Tel.	..	..
Commercial Cable	185	175	Marconi Tel.	..	..
Electric Boat	25	25	Western Union Tel.	88⅝	88¼
Electric Boat pfd.	61	60	Westinghouse com.	158	153¾
Electric Lead Reduction	⅛	⅛	Westinghouse pfd.	175	175

BOSTON.

	Apl. 26	May 5		Apl. 26	May 5
American Tel. & Tel	126	126¼	Western Tel. & Tel. pfd.	*80	77
Cumberland Telephone	113	113½	Mexican Telephone	1¼	1⅜
Edison Elec. Illum.	238	238	New England Telephone	*123	*122½
General Electric	160¼	158¼	Mass. Elec. Ry.	20	19¾
Western Tel. & Tel	..	8	Mass. Elec. Ry. pfd.	73	72¾

PHILADELPHIA.

	Apl. 26	May 5		Apl. 26	May 5
American Railways	44	44	Phila. Traction	..	96
Elec. Storage Battery	57	57	Phila. Electric	5⅜	5¼
Elec. Storage Battery pfd.	57	57	Phila. Rapid Trans.	13½	13¼
Elec. Co. of America	7¼	7¼			

CHICAGO

	Apl. 26	May 5		Apl. 26	May 5
Central Union Tel.	..	..	National Carbon pfd.	102½	103
Chicago Edison	..	..	Metropolitan Elev. com.	15	15
Chicago City Ry.	155	158	Union Traction	5½	5½
Chicago Tel. Co.	..	..	Union Traction pfd.	30¼	30¼
National Carbon	28	30			

*Asked

SAN FRANCISCO GAS AND ELECTRIC COMPANY makes the following report for the year ended December 31, 1903:

	1903.	1902.	Changes.
Total income	$2,504,771	$1,989,834	Inc. $514,937
Operating expenses	1,534,814	1,285,897	Inc. 248,917
Net	$969,957	$703,937	Inc. $266,020
Depreciation, etc., funds	395,000	282,101	Inc. 112,899
Balance	$574,957	$421,836	Inc. $153,121
Dividends	396,211	.....	.....
Surplus	$178,746	.....	.....

Net profits and consumers for the last four years follow:

	1903.	1902.	1901.	1900.
Net profits	$969,957	$703,937	$458,440	$675,556
Consumers Dec. 31:				
Gas	65,710	35,791	34,271	30,800
Electricity	9,771	5,238	4,286	2,325

NEBRASKA TELEPHONE COMPANY.—The Nebraska Telephone Company reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.
Gross	$1,049,907	$905,660	$754,971
Expenses	857,310	737,220	617,345
Net	$192,597	$168,440	$137,626
Dividends	115,768	99,000	81,222
Surplus	$76,829	$69,440	$56,040

SAO PAULO LIGHT & POWER.—The Sao Paulo (Brazil) Tramway, Light & Power Company, in which Canadian and American capital is interested, reports as follows for the year ended December 31, 1903, Canadian currency equivalent:

	1903.	1902.	1901.
Gross Railway Company	$962,941	$879,907	$630,282
Gross earn. Light & Power Co., etc.	340,234	243,378	119,394
Total gross	$1,303,175	$1,123,285	$749,676
Expenses (both)	403,747	417,916	486,719
Net	$899,428	$705,369	$262,957
Charges	286,885	250,000	.....
Surplus	$612,543	$455,349	$262,957
Dividends	391,379	239,019	.....
Surplus	$221,164	$216,350	$262,957

PITTSBURGH TROLLEY YEAR.—The Pittsburg Railways Company in its report for the year ended March 31, 1904, shows gross $8,661,394, net income $3,612,169, deductions and fixed charges, $3,628,246, leaving a deficit of $16,077 as against a surplus last year of $1,152,251, out of which $870,000 was paid in dividends. The traffic statistics are as follows:

Passengers carried	174,400,055	164,407,446	Inc.	9,992,609
Car mileage	34,748,836	33,577,214	Inc.	1,171,622
Earn per car mile	25.32c	24.65c	Inc.	1.07c
Exp. & tax per car m.	14.92c	14.33c	Inc.	.59c
Net per car mile	10.40c	10.32c	Inc.	.08c

The company's business was seriously affected by the hard winter with respect to lower receipts and higher operating expenses. It built 34.53 miles of new track and bought 200 cars.

STANDARD UNDERGROUND CABLE COMPANY shows as follows for the year ending December 31, 1903:

Gross	$8,685,294
Material on hand	507,325
Total	$9,192,619
Exp., disc., factory cost, etc.	8,488,181
Net	$704,438
Dividends	229,732
Surplus	$474,706
Previous surplus	754,407
Total	$1,229,113

MICHIGAN TELEPHONE DIVIDEND.—The Michigan State Telephone Company has declared a quarterly dividend of 1½ per cent. on the preferred stock, payable June 1 to stockholders of record May 1. Detroit Telephone bondholders participate in this dividend, as under the settlement they got $480 in bonds of the Michigan State Company, $206.25 preferred stock and $428.75 common and $2.50 in cash, in lieu of January interest, on each $1,000 Detroit Telephone bond. A voluntary payment of some kind will be made to minority stockholders of Michigan Telephone Company when other matters are cleared up.

BELL TELEPHONE STOCKHOLDERS.—The following figures will show the number of stockholders of the American Telephone & Telegraph Company.

Jan. 1	Amt. capital stock.	No. shareholders.
1903	$87,836,100	10,802
1904	127,068,900	15,743

Since January 1, 1904, the number of shareholders has increased over four hundred.

THE NEW ENGLAND (BELL) TELEPHONE AND TELEGRAPH COMPANY reports as follows for the year ended December 31, 1903:

	1903	1902.	1901.	1900.
Gross	$6,092,865	$6,024,610	$5,177,412	$4,518,396
Exp. & tax	4,677,726	4,855,841	4,139,930	3,621,644
Net	$1,415,139	$1,168,769	$1,037,482	$896,752
Dividends	1,297,002	1,108,726	947,406	838,635
Surplus	$118,137	$60,043	$90,076	$58,117

MARCONI WIRELESS.—At a meeting of the directors of the Marconi Wireless Telegraph Company of America, John D. Oppe was elected second vice-president and general manager, vice William H. Bentley, resigned. Mr. Bentley remains a member of the board and will continue his interest in the affairs of the company. Mr. Oppe is also general manager of the Canadian Marconi Company.

NEW YORK METROPOLITAN.—Kuhn, Loeb & Company have purchased $2,250,000 Central Crosstown Railroad Company 2-year 5-per-cent notes, secured by bonds of that company, which are guaranteed by the Metropolitan Street Railway Company.

Commercial Intelligence.

THE WEEK IN TRADE.—There are signs of improvement in trade, and with the advent of the belated spring weather it will no doubt be realized. At most markets distribution is quiet, and trade for April, the country over, does not equal that for the same month last year. In the northwest, conditions are somewhat improved and business has been helped by the more seasonable weather. Pacific Coast trade and crop advices are better than of late, and while weather and crop conditions are backward in the South the outlook for the future is very hopeful. Collections are still backward, though some improvement is noted at centres where the weather has permitted a better distribution of goods. Among the industries the demand for pig iron is rather dull. Finished products are quieter, but it is pointed out that the demand for the smaller products is inducing a production of steel not much below the high record of a year ago. Export trade is expanding, thus removing the fear of a burdensome surplus of products. The demand for building materials is improving with the better weather conditions, and cessation of strikes, special activity being reported at Western cities and on the Pacific Coast. In short, trade in general reflects the weather conditions, improvement being reported from some localities, and stagnation from others. The business failures do not appear to exceed the normal number, the aggregate for the week ending April 28, as reported by Bradstreet's being 197, against 199 the week previous and 173 the corresponding week last year. The copper market continues dull, although it is stated that some good-sized orders have been placed during the past few days for electrolytic and casting copper by wire and brass makers. Holders of the metal, however, are firm in their views as to its market value and are not disposed to make any concessions. Lake stiffened ¼c. during the week, closing officially, at 13⅜c. @ 13⅝c; electrolytic 13⅛c. @ 13¼c.; casting stock 12⅞ @ 13⅛c. The London market has advanced.

CAMPECHE TO HAVE ELECTRIC LIGHT.—Campeche, capital of the State of Campeche, Mexico, is to have an up-to-date Yankee electric lighting plant. A concession has already been granted by the State authorities which sanctions the construction and operation of the system for a period of twenty years. The franchise was originally made out in the name of Jose de las Munecas Zimavilla, a prominent Campeche lawyer, who has made over the permit to a joint stock company, which has been organized under Mexican laws, with a capital of $150,000. W. E. Herrmann, of Mexico City, is largely interested in the enterprise. The electrical expert who will have charge of the construction and equipment of the Campeche plant is A. A. Chaillet, at present located in Mexico City, at one time technical director of the Shelby (Ohio) Electric Company. He is now managing director of a company formed last year in Mexico for manufacturing incandescent lamps. The initial capacity of the Campeche plant will be 40 arc and 2,000 incandescent lamps.

THE FIBRE CONDUIT COMPANY, of Orangeburg, N. Y., find that between March of 1903 and March of 1904 their business increased near 300 per cent., and that during that period they had the most successful year in the history of the company. The most successful month they have experienced was April, 1904. Among their recent orders for conduit, which orders have been shipped in carload lots or nearly so, were those for the Edison Electric Illuminating Company, of Brooklyn; Citizens' Telephone Company, of Grand Rapids, Mich.; Merchants' Heat and Light Company, of Indianapolis; the Boston Edison Company; the Detroit Edison Company; the Suffolk Light, Heat and Power Company, of Southampton, L. I.; the General Electric Company; Westinghouse Electric and Manufacturing Company, and the United States Naval Academy at Annapolis.

BUFFALO FORGE ORDERS.—The Buffalo Forge Company, Taylor Building, Cortlandt Street, has secured contracts from the Lehigh Valley Railroad for a big lot of exhaust fans, etc., which will be electrically operated. For the forge shops at Sayre, Pa., two 10-ft. exhaust fans and four No. 11 blowers have been ordered. The fans are to be belted to motors of 50-hp capacity each and the blowers will be direct-connected to 30-hp motors. For the locomotive shops, ten 10-ft. fans have been ordered. These fans will each be driven by 20-hp motors. The American Malting Company, New York, has ordered a 40-hp Buffalo engine for direct connection to a Westinghouse generator.

STEEL BY ELECTRICITY.—The government commission sent to Europe by the Canadian Government to investigate the electrothermic processes employed in the smelting of iron ores and the making of steel has returned. It is reported from Toronto that the commission has found the process feasible and reports that steel can be produced by the electro-thermic process at a total cost of $8 per ton. This is taken to mean that the smelting of iron ores by electricity is commercially feasible in Canada and that the development of Canada's water power and iron deposits is a thing of the near future.

OLD EQUIPMENT TO GO TO CUBA.—The old equipment in the Central Building, 143 Liberty Street, consisting of six United States Electric belted generators and three Westinghouse engine aggregating about 200-kw capacity, is to be shipped to C. H. Thrall & Co., engineers and contractors, Havana, Cuba, in which firm J. P. Hall, the electrical contractor, is interested. The new plant to be put in the Ceneral Building, the contract for which Mr. Hall has secured, will be of 300-kw capacity and will consist of three 100-kw C. & C. generators direct-connected to Ball & Wood engines of 150-hp capacity each.

HAVANA LIGHTING PLANT ENLARGED.—A reorganization scheme is contemplated regarding the Spanish-American Light & Power Company Consolidated, which holds the exclusive franchise for lighting Havana and Matanzas, Cuba. Mr. Hayward, of the Baltimore gas plant, engineering and contracting firm of Bartlett, Hayward & Co., is president of the company. It is planned to reduce the capital of the company and to incorporate the concern under Cuban laws. The plant at Havana will be considerably enlarged. M. Jiminez is the electrical engineer of the company.

LAMP POOL.—Another meeting of the incandescent lamp manufacturers is, it is said, to be held in Cleveland this week, again bringing together the working forces of the National Electric Lamp Company and the "Independent" companies. The purpose of the meeting has not been divulged, but it is presumed to be for the purpose of further adjusting the agreement entered into at the meeting of the same parties held at the Manhattan Hotel a few weeks ago. The action of the "pool" are being watched with great interest.

MOTORS FOR CENTRAL AMERICAN MINES.—The Mine and Smelter Supply Company, 139 Liberty Street, is shipping large lots of concentrating tables to Mexico, Honduras and Costa Rico, which are to be operated by small motors built by the General Electric Company, the Triumph Electric Company and the Northern Electrical Manufacturing Company. The company has also some orders in hand for electric drilling equipments to be driven by General Electric motors.

1500 HP FOR MEAT PLANT.—The New York Butchers' Dressed Meat Company has just placed contracts for 1500 hp of electrical equipment to be installed in its plant at 39th Street and 11th Avenue. The engines will be built by the Fitchburg Engine Company. There will be two 600-hp tandem compound direct-connected machines and one of 300-hp capacity. The generators will be General Electric of 400-kw and 200-kw capacity respectively.

EQUIPMENT FOR TUXTLA GUTIERREZ.—The municipal lighting plant at Tuxtla Gutierrez, the capital of the state of Chiapàs, Mexico, is to be doubled. The existing equipment takes care of 1,500 incandescent and 50 arc lamps. General Rafael Pimentel, governor of the state, is now perfecting financial arrangements for the additional machinery. Mexican advices also state that he has other electrical projects in view.

HUGE CUBAN SUGAR PLANT.—The Colonial Sugar Company, of which M. R. Spelman, 33 Wall Street, is president, is about to construct the largest sugar plant in the world at Constancia, Santa Clara, Cuba, in which electricity will play an important part. The centrifugal pumps will be operated by electric power, as also the sugar cars. The capacity of the plant will be 5000 tons of cane per day.

CONSOLIDATION AT ROCHESTER, N. Y.—It is stated that negotiations are under way to merge the Rochester Gas and Electric Company, Rochester Light and Power and Rochester Railway Company. This city was the scene not long ago of a large electric lighting consolidation. Rochester is one of the pioneer trolley cities and has a large system.

HEINE AFTER MEXICAN BOILER CONTRACTS.—The Heine Safety Boiler Company is closing some fair-sized orders through the engineering and contracting firm of Van Voorhis & Sanford, of Monterey, Nuevo Leon, for boilers to be installed in Mexican power plants.

EQUIPMENT FOR FEDERAL SUGAR PLANT.—The Federal Sugar Refining Company's plant at Yonkers, N. Y., is to be equipped with considerable electrical machinery. Three 160-hp American Ball single engine, direct connected to General Electric generators of 100-kw capacity each will be installed.

LIGHTING EQUIPMENT FOR NEW JERSEY DRUG FACTORY.—The Northern Engineering Company, incorporated, White Building, has secured the contract for lighting equipment to be installed in Dodge & Olcott's new drug factory at Bayonne, N. J.

TRUMBULL SPECIALTIES FOR CUBA.—The Trumbull Electric Company, 136 Liberty Street, has secured a large contract for its various specialties from the Spanish-American Light and Power Company, Consolidated, of Havana, Cuba.

MANUFACTURED U. S. EXPORTS.—Exports of manufactures still promise to exceed in the fiscal year 1904 those of any preceding year. The nine months' figures of the fiscal year, just announced by the Department of Commerce and Labor, through its Bureau of Statistics, show a total of 17 million dollars greater than the corresponding months of the fiscal year 1900, in which the exports of manufactures reached their highest figures. In 1900 the exports of domestic manufactures amounted to 433 million dollars for the whole fiscal year, which was the highest figure ever recorded for the exports of domestic manufactures from the United States. In 1901 the figures showed 411 million dollars, in 1902, 403 million dollars, and in 1903, 407 million dollars. In this comparison it must not be forgotten that the 1904 figures exclude the exports of Porto Rico and Hawaii. Imports of manufactures show a decided falling off in the nine months ending with March, 1904, as compared with the corresponding period of 1903. To obtain a statement of the imports of manufactures, the Bureau of Statistics groups in three classes, viz., wholly or partially manufactured materials for use in manufacture; manufactured ready for consumption; and the group articles of voluntary use, luxuries, etc.; and this gives approximately the value of all manufactures coming into the United States, and amounts in total to $334,815,956 in the nine months ending with March, 1904, against $366,107,747 in the same months of last year, a decrease of 32 millions in imports of manufactures. It is proper to add, however, that the group "articles of voluntary use, etc.," contains some articles which could not properly be classed as manufactures, especially diamonds, of which the importation has grown steadily for several years past until the present fiscal year, which shows a decided falling off compared with 1903.

ALASKA CABLE.—A Washington despatch states that Gen. Greely, Chief Signal Officer of the army, has decided to award the contract for the manufacture of about 625 miles of submarine cable to the Safety Insulated Wire and Cable Company of New York. This cable will be used to connect Sitka, Alaska, with Fort Liscum, near Valdez, on Prince William Sound. The cable will be shipped by rail from New York to Seattle and will probably be laid the coming summer. The cable ship Burnside arrived at Nagaskai, Japan, recently, on her way to Seattle. Upon arrival there she will take on board about 800 miles of cable for laying between Sitka and Seattle. When these cable connections are completed, it will be possible to telegraph from the United States to every principal town and military post in Alaska without using Canadian lines.

STERLING ELECTRIC ORDERS.—The Sterling Electric Company, of Lafayette, Ind., has just equipped one of the large department houses at Springfield, Ohio, with a complete telephone system to work in connection with the city exchange it has recently installed there. It reports also an order for a private branch exchange from a bank in Albany, N. Y.; and an order for protectors and other apparatus from the Canton, Ill., Home Telephone Company. It has also just completed a 4-position toll board for the U. S. Telephone Company for Springfield, Ohio; the installation of a 3000-line common battery switchboard at Chillicothe, Ohio, and the installation of its 4-party line system in five of the largest cities in the West.

PLANTS FOR NEW BUILDINGS.—The Thompson-Starrett Company is about to take figures for electrical equipment to be installed in various hotel and office buildings for the construction of which they have the contracts. The Zimmerman Hotel at Richmond, Va., now being built, will have a 200-hp lighting outfit. The building will be a 10-story one. Four elevators will be put in. The new Woodruff Hotel, Brooklyn, will have a 300-kw. lighting and general power equipment. The Rockfeller skyscraper office building to be constructed in Cleveland will have a 400-kw. electrical plant. Mr. Babbit, formerly associated with the Chicago Edison Company, is the electrical engineer of the Thompson-Starrett Company.

N. Y. CENTRAL POWER PLANT.—The first actual local work towards the changing of the motive local power of the trains which run through the tunnel from the Grand Central station to Ninety-sixth Street, from steam to electricity, was made last week, when foundations plans were filed in the Bronx Bureau of Buildings for power house. This power house will be located on the south side of One Hundred and Forty-ninth Street, only 95 ft. from Long Island Sound. It will be a three-story brick structure of large dimensions; being 236.6x156.4 ft. The New York Central Railroad will erect the building, and the plans have been drawn by C. Wellesley Smith, the architect of the railroad.

TO SELL SHEPHERD ENGINES.—The firm of Mackenzie, Quarrier & Ferguson, 114 Liberty Street, New York, has effected an arrangement with the Shepherd Engineering Company, of Franklin, Pa., to act as sales agent for the Shepherd vertical automatic engine in the States of New York and New Jersey. These engines are built in sizes up to 1500 hp and in single, steeple and cross compound, single valve and four-valve types. The firm will continue to represent the selling end in this territory of the Harrisburg Pennsylvania Foundry and Machine Works for the Harrisburg horizontal engines.

EQUIPMENT FOR BROOKLYN TRAINING SCHOOL.—The Brooklyn Manual Training School is to be equipped with a considerable quantity of electric machinery. Frank Dobson, 218 East Forty-second Street, New York, is the general contractor. Manning, Maxwell & Moore secured a large order for machine tools to be electrically operated. There will be upwards of 600 hp of motors. The Buffalo Forge Company has taken an order for a marine type cross compound engine to be direct-connected to a generator. This outfit will be used to drive experimental apparatus in the laboratory.

LIGHTING EQUIPMENT FOR FERRIES.—The Hoboken Ferry Company has let the contract for the equipment to light the Erie, Jersey Central and Delaware, Lackawanna & Western ferry houses, West Twenty-third Street, New York. The machinery will have a capacity of 350 kw. There will be two 190-hp Harrisburg standard side crank engines direct-connected to 125 kw, General Electric generators and one 160-hp engine direct-connected to a 100-kw generator. The contracts were awarded through Kenneth M. Muchison, Jr., 5 W. Thirty-first Street, New York.

CHRISTCHURCH N. E. POWER HOUSE.—The New England Electric Construction Company, of Christchurch, which has secured the contract, valued at $1,250,000, for the construction and equipment of a 30-mile electric traction system in that city, is ordering more power house equipment in this market. The Alberger Condenser Company has taken the order for the surface condensers and cooling towers to take care of a 1000-kw generating outfit. The boilers will be Babcock & Wilcox. Curtis turbines two units of 500-kw each will be installed.

SHAW CRANES FOR SWEDISH IRON WORKS.—Manning, Maxwell & Moore have secured a contract for an electric traveling crane of 30 tons capacity equipped with two trolleys for installation in the open hearth plant of the Sanviken Iron Works—the largest iron and steel manufacturing concern in Sweden. The crane, which will be a duplicate of an outfit shipped the same Scandinavian works eight years ago, is to be built by the Shaw Electric Crane Company.

THE NERNST IN NEW ENGLAND.—The Nernst lamp is becoming widely introduced in New England. The company has recently received two large orders, one from the Saco & Pettee Machine Shops, Biddeford, Me., for 575 three-glower lamps, and one from the Arlington Mills, Lawrence, Mass., for 600 lamps of the 44-watt type. The second order comes in the form of a testimonial, as quite a large installation of Nernst lamps had already been made in the mills.

FANS FOR INDIA.—The Fidelity Electric Company, manufacturers of electric fans, Lancaster, Pa., is in receipt of a good-sized order for its Eclipse desk fans for India, and has just filled a large order for ceiling fans for the Orient. All southern Asia is badly in need of fan motors and the Fidelity Company is doing what it can to make life pleasant there.

LIGHTING PLANT FOR TEPIC, MEX.—The municipal authorities of Tepic, a town of 15,000 population in the State of Jalisco, Mexico, are having plans drawn up for the construction of an electric lighting system which will have American equipment. General Pablo Rocha y Portee, the governor of the territory, is primarily concerned in the project.

EQUIPMENT FOR TAMPA PLANT.—The Tampa (Fla.) Electric Company is about to increase the capacity of the plant. The company is managed by Stone & Webster, of Boston, Mass. The Hooven, Owens & Renschler Company, of Hamilton, Ohio, has secured an order for a 750-hp cross compound condensing engine for direct connection to a General Electric generator.

WELLINGTON, N. Z. SYSTEM TO BE EXTENDED.—The municipal electric traction system now being built at Wellington, New Zealand, by Macartney, McElroy & Company, Limited, Havemeyer Building, is to be extended at an additional expenditure of nearly $350,000.

MORE EQUIPMENT FOR WEST AUSTRALIA.—The Perth Electric Tramways, Limited, of 3 Lawrence Poultney Hill, London, E. C., is about to extend its power plant. The present system was built and equipped by J. G. White & Co. It is somewhat over 10 miles long.

VARIOUS EQUIPMENT FOR MEXICO.—The export house of Loiza & Co., 54 Broad Street, New York, has received a contract valued at about $50,000, which calls for the shipment of various electrical equipment to Mexico.

EQUIPMENT FOR ONTARIO POWER PLANT.—The Ontario Power Company's plant at Niagara is to have a 50-ton Shaw electric traveling crane with a span of 77 feet.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electrochemical Society. Secretary S. S. Stadtler, 39 S. 10th St., Philadelphia. Next meeting, St. Louis, Sept. 12-17, 1904.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, St. Louis, Sept. 13, 1904.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, St. Louis, Oct. 4, 1904.

American Street Railway Association. Secretary, T. C. Pennington, 2020 State Street, Chicago. Next meeting St. Louis, Mo., Oct. 12 and 13, 1904.

Association of Edison Illuminating Companies. Secretary, W. S. Barstow, New York City and Portland, Ore.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., June 15, 16 and 17, 1904.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col. Annual meeting last Wednesday in October.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

Engine Builders' Association of the United States. Secretary, D. Fleming, Harrisburg, Pa.

Electrical Contractors' Association of New York State. Secretary, F. Fish, Rochester, N. Y. Next meeting, Utica, July 19, 1904.

Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

Illinois State Electric Association. Secretary, H. E. Chubbuck, LaSalle, Ill.

Indiana Public Utilities Association. Secretary, A. M. Barron, South Bend, Ind. Next meeting, Indianapolis, Ind., Oct. 18, 1904.

Independent Telephone Association of the United States of America. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago. Next meeting, St. Louis, Sept., 1904.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Pichardt, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, St. Louis, Sept. 13 and 14, 1904.

International Electrical Congress. General secretary, Dr. A. E. Kennelly, Cambridge, Mass. Meeting, St. Louis, Sept. 12-17, 1904.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky.

Iowa Electrical Association. Secretary, W. S. Porter, Eldora, Ia. Next meeting, Dubuque, Ia., April, 1905.

Iowa Telephone Association. Secretary, C. C. Deering, Des Moines, Ia. Next meeting, second Tuesday, March, 1905.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ind.

Maine Street Railway Association. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind. Next meeting, St. Louis, July, 1904.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, St. Louis, Mo., September 14, 15 and 16, 1904.

National Electric Light Association. Secretary, Ernest H. Davis, Williamsport, Pa. Next meeting, Boston, Mass., May 24, 25 and 26, 1904. Headquarters, Hotel Vendome.

New England Street Railway Club. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, St. Louis, Sept., 1904.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Sandusky, Ohio, Aug. 16, 17 and 18, 1904.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, C. J. Miller, Canton, Ohio. Next meeting, Columbus, O., May 13, 1904.

Pacific Coast Electric Transmission Association. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal. Next annual meeting June 21, 1904.

Southwestern Electrical Association. Secretary, J. L. Ellis, Oklahoma City, Okla.

Southwestern Gas, Electric & Street Railway Association. Secretary, Frank E. Scovill, Austin, Texas.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt. Next meeting, Montpelier, Sept. 21 and 22, 1904.

Western Society of Engineers, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

General News.

THE TELEPHONE.

SITKA, ALASKA.—The Long Distance Telephone Company will build a line to Unalakleet from Chinik, the present terminus of the line.

MARVELL, ARK.—The Marvell Telephone Company has been incorporated with a capital stock of $20,000. The directors are E. E. McMurray and others.

LITTLE ROCK, ARK.—The New Long Distance Telephone Company has been incorporated with a capital stock of $200,000. J. B. Kin is president and general manager.

LOS ANGELES, CAL.—An ordinance is being prepared requiring the reconstruction of conduit each year by the telephone and lighting companies.

CAMPUS, CAL.—The Campus Telephone Company has been incorporated with a capital stock of $2,500, by J. D. Brophy, M. R. Walsh, N. L. Mamer and others.

TWO ROCK, CAL.—The residents of Two Rock have organized the Two Rock Valley Telephone Company. George Gaston is secretary of the company. The line will be 25 miles long.

SANTA ROSA, CAL.—Sealed bids will be received by F. L. Wright, county clerk, until May 7, for a franchise to construct and maintain a telephone system in Sonoma County, as applied for by J. M. Laughlin. Bids will also be received at the same time and place for similar privileges applied for by C. L. Patterson.

WATERBURY, CONN.—The Waterbury Automatic Telephone Company has increased its capital stock from $10,000 to $50,000.

WASHINGTON, D. C.—The Terra Telephone Company has been incorporated with a capital stock of $100,000. The directors are E. Schooley, F. C. Geiger and others.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the District Commissioners until noon, May 7, for furnishing underground signal and telephone cables for the electrical department of the District of Columbia.

BARTOW, FLA.—Mr. J. M. Oliver, of Orlando, is making arrangements to build a telephone line from Jacksonville to Tampa by way of Bartow. The enterprise is to be known as the Florida Co-operative Telegraph & Telephone Company and will be incorporated at $100,000. Building operations of this system will begin about May 15.

JACKSONVILLE, FLA.—The Southern Bell Telephone & Telegraph Company is stringing a direct copper-wire line between Jacksonville and Fernandina. There will be four wires on the new line.

PEORIA, ILL.—The Interstate Telephone Company will install a service here.

HARDIN, ILL.—The Calhoun Telephone Company has increased its capital from $15,000 to $25,000.

EDWARDSVILLE, ILL.—The Oak Grove Telephone Company has been organized in Fort Russell Township.

MATTOON, ILL.—The Gayes Mutual Telephone Company of Mattoon has increased its capital stock from $2,400 to $4,980.

CHICAGO, ILL.—The Chicago Telephone Company has secured a 20-year blanket franchise, covering all the towns in Lake County. The grant is not exclusive.

DANVILLE, ILL.—A contract for the new building of the Vermillion County Telephone Company has been awarded at $16,000. Mr. H. B. Walter will erect the building.

ATHENS, ILL.—The Menard County Telephone Company has been organized and has received a franchise. Toll lines will be built to connect with the Interstate Independent Telephone & Telegraph Company at Springfield and other points.

CHICAGO, ILL.—The directors of the Automatic Electric Company have declared the regular quarterly dividend of two per cent., payable May 2. The company is reported in a prosperous condition. It was stated that 26 cities are now using the automatic telephone system and when present contracts are filled the system will be used in 59 cities. It was stated that by May 15 the Illinois Tunnel Company will have about 8300 instruments in operation in the downtown district of Chicago.

JASPER, IND.—The Velpen, Ireland and Atwell Telephone Company has sold its plant to the Dubois County Telephone Company at Huntingburg.

INDIANAPOLIS, IND.—The American Telephone & Telegraph Company is getting the right of way for a trunk line to extend from Chicago to this city.

ST. JOSEPH, IND.—The German Township Home Telephone Company, recently organized with 65 members, is constructing an exchange at this place.

PROVIDENCE, IND.—The Providence Telephone Company is running its line to Banta and Trafalgar. The company contemplates putting in a new switchboard this summer.

HEBRON, IND.—A telephone line between this place and Macksburg has been completed and as soon as the exchange is installed, service will be given a large number of patrons.

COLFAX, IND.—The American Telephone & Telegraph Company proposes to build a trunk line from Chicago to Indianapolis and the work of securing the right of way is now proceeding.

LAWRENCE, IND.—The Lawrence Telephone Company has incorporated with a capital stock of $10,000. The directors are M. M. Hindman, L. H. Rattliff and Harry Mollenkopf.

CLEVELAND, IND.—The Cleveland Telephone Company, of Hancock County, has been incorporated with a capital stock of $160, by E. H. Thomas, Ada L. Sample, E. L. Furry and others.

CHESTERTON, IND.—The town council has granted a franchise to the

Portage Home Telephone Company. The rates are limited to $1 and $1.25 per month for residence and business telephones.

ELKHART, IND.—The Home Telephone Company, of this city, is laying 14,000 feet of new additional cable. This was necessary to the installing of the many new telephones which have been applied for.

GREEN CASTLE, IND.—A new telephone company has been organized in Madison township. The officers are Charles Kyte, president; Zimri Boswell, vice-president; J. N. Dalby, treasurer, and Thomas Heady, secretary.

FLORA, IND.—A combination of the independent telephone companies of Flora, Delphi, Frankfort, Logansport and Kokomo has been effected for mutual protection against the invasion of co-operative systems in this section.

LAFAYETTE, IND.—The Lafayette Telephone Company suffered an annoying accident on April 16. An electric light wire came in contact with one of the telephone leads and about 1200 instruments were disabled and a number damaged.

LAWRENCE, IND.—The Lawrence Telephone Company has increased its capital stock $10,000 for the purpose of extending its lines, installing a new switchboard and making other betterments. M. M. Hindman is president and L. H. Ratliff, secretary.

BATTLE GROUND, IND.—The Cairo Telephone Company, of this town, has sold its plant and property to Eldon T. Roadrick, of Brookston, one of the original stockholders. Mr. Roadrick announces that he will extend the lines and improve the plant.

ROYAL CENTER, IND.—G. S. Akers, of Ambia, Ind., has purchased the Thomas-McCombs telephone plant in this city. Mr. Akers announces that he will at once put in a new and improved switchboard. He will also make extensions and other improvements.

BICKNELL, IND.—The Bicknell Telephone Company has increased its capital stock in the sum of $12,000. The object is to extend its lines, improve the plant and increase the capacity of the switchboard. Joseph Bare is president and John S. Hoover, secretary.

INDIANAPOLIS, IND.—The Northwestern Long Distance Telephone Company, of Mohawk, Hancock County, has incorporated with a capital stock of $2,000. J. W. Murphy, Sr., Emory Pratt, G. W. Allen, J. M. Duneau and Clint Parker are the incorporators.

EVANSVILLE, IND.—It has been stated by the directors and a few stockholders of the Evansville Municipal Telephone Company that an attempt will be made to form a local independent company entirely eliminating the municipal feature and putting it on the basis of other independent companies.

NEW CASTLE, IND.—The Cadiz Telephone Company, the original and largest co-operative telephone company in this county, will in the future have no affiliation with the Bell interests. At a recent meeting of the stockholders, a resolution was passed, declaring that all business in the future will be done with independent companies.

SOUTH BEND, IND.—The annual meeting of the South Bend Home Telephone Company was held recently and Theodore Thorward was elected president, M. B. Slatey, treasurer, and Elmer Stoll, secretary. C. H. Worden heads the board of directors. The company is in a flourishing condition and declared a regular semi-annual dividend of two per cent.

CORYDON, IND.—The Eureka Telephone Company will make a number of extensions of its lines at once. The company has issued a new directory which shows that it has three exchanges in the county with telephones as follows: Corydon, 170; Laconia, 166; Mauckport, 85. The following are the officers: Ed. F. Windell, president; Chas. Yeager, vice-president; H. P. Beanblossom, secretary; L. S. Fleshman, treasurer.

ELWOOD, IND.—Sixty-five more farmers on the rural lines were connected by telephone with Elwood recently. One hundred and thirty applications are also waiting to be approved by the telephone company. The Delaware and Madison Counties Telephone Company, the independent line, is working along the rural lines and five new circuits have been built to meet the demand. Over 300 farms are already connected with the local exchanges.

NAPOLEON, IND.—The citizens of Delaware and Laughery townships, Ripley County, have organized a stock company to build a telephone system from Napoleon, Laughlin township, to connect with Dr. Gibson's line which runs into Batesville. The officers are: President, John Bullman; secretary-treasurer, Granville Thackery. Work on this line will begin as soon as the officials can purchase the material and contract for its construction.

INDIANAPOLIS, IND.—The leases on the property and equipment of the New Telephone Company have been signed over to the Indianapolis Telephone Company, which was organized recently to take the property of the New company and extend and improve the service. The Indianapolis Telephone Company has also taken a mortgage from the New company for $150,000, which covers the floating indebtedness, and all future work of extending the lines, laying new cables and installing branch exchanges will be done by the Indianapolis company.

BOISE, IDA.—The Rocky Mountain Bell Telephone Company has definitely announced its decision to extend its lines as far as the famous Thunder Mountain district as soon as the state road to that point, 75 miles in length, is completed.

SCHLESWIG, IA.—The Schleswig Telephone Company has bought material for 20 miles of extensions.

WEST UNION, IA.—The Rogers Telephone Company has been formed with a capital stock of $25,000.

ELDON, IA.—Mr. C. A. Mann, of Sioux City, has bought the Eldon Telephone Company and will improve and extend the service.

CONESVILLE, IA.—The Conesville Telephone Company has been incorporated with a capital stock of $10,000. J. G. Van Lent is president.

CEDAR FALLS, IA.—A stock company has been formed to install an independent telephone system here. N. H. Harris is president and F. O. Jackson, secretary.

OLATHE, KAN.—The De Soto & Olathe Telephone Company has filed articles of incorporation, the capital being $2,000.

JUNCTION CITY, KAN.—The Union Telephone & Telegraph Company's new toll line to Topeka is now in operation. It furnishes the independent companies of central Kansas connection with Kansas City and other eastern points, and its construction cost the company $125,000.

FLEMING, KY.—The Ewing Mayslick Telephone Company, of Fleming, has been incorporated.

NEW ORLEANS, LA.—An effort is being made to have all telephone and telegraph wires placed underground on Canal Street, between Liberty and City Park Avenue.

LAUREL, LA.—The Cumberland Telephone Company has acquired possession of the Mississippi Telephone Company, of this place. Both the Laurel and Ellisville exchanges are included in the deal and half of the line between here and Hattiesburg.

ROCKLAND, ME.—The Northwestern Telephone Company is securing permission to enter Lewiston and Auburn.

SKOWHEGAN, ME.—The New England Telegraph & Telephone Company has decided to install a system here.

NEW BEDFORD, MASS.—The Automatic Telephone Company, it is stated, contemplates increasing its capital stock to extend its business to adjacent towns.

KALAMAZOO, MICH.—The Citizens' Telephone Company will spend $80,000 in improvements in this city.

LANSING, MICH.—The Citizens Telephone Company will make several extensions and improvements to its system during the coming summer. All the new work will be made with a view to the early installation of the automatic system.

TORDENSKJOLD, MINN.—The Independent Mutual Telephone Company will extend its line 35 miles.

ARLINGTON, MINN.—The Merchants' Telephone Company has been incorporated with a capital stock of $4,000.

OSSEO, MINN.—The Rural Telephone Company has been organized to build a line in Hennepin and Wright counties. The capital stock is $50,000.

JACKSON, MISS.—The Cumberland Telephone Company is changing its local exchange to the central energy system and will reconstruct a large amount of pole line.

OTTERVILLE, MO.—The Otterville-Smithton Telephone Company has increased its capital from $2000 to $5000.

DE KALB, MO.—The DeKalb Telephone Company has been incorporated with a capital stock of $10,000. The directors are W. W. Head, C. V. Davis and others.

DEWITT, NEB.—The Dewitt Telephone Company has increased its capital stock to $20,000, and will make extensive improvements in its exchange.

OMAHA, NEB.—The Farmers' Telephone Company, of Alexandria, Thayer County, has been incorporated with a capital stock of $5,000.

OMAHA, NEB.—The new central energy automatic switchboard of the Nebraska Telephone Company was recently cut into srvicve. It cost $250,000.

ENDICOTT, NEB.—The Endicott Telephone Company has filed articles of incorporation, the capital stock being $2,500. The incorporators are H. Stolz, H. E. Potter, J. A. Blausett.

SWEDESBORO, N. J.—The People's Rural Telephone Company contemplates extending its lines to reach several towns in this vicinity. Forty miles of line will be erected and 120 telephones have been subscribed for.

HOPEWELL, N. J.—The Hopewell Telephone & Construction Company has agreed to sell its local system to the Delaware & Atlantic Telephone & Telegraph Company. The system will be transferred about May 15 when the Bell interests will come in possession.

TROY, N. Y.—The Commercial Union Telegraph Company of this city has increased its capital stock from $10,000 to $800,000.

AMSTERDAM, N. Y.—The Amsterdam Automatic Telephone Company has increased its capital stock from $15,000 to $100,000.

POUGHKEEPSIE, N. Y.—The Dutchess County Telephone Company will make some important extensions to its service. Exchanges will be installed in several places.

BABYLON, L. I., N. Y.—The village board has granted permission to the New York & Long Island Telephone Company to come into Babylon by an underground circuit.

KILLAWOG, N. Y.—The Rural Telephone Company has been organized here by business men and farmers. The directors are T. R. Hitt, president; C. J. Tarble, vice-president; W. C. Ensign, secretary, and P. Hilsinger, treasurer.

SYRACUSE, N. Y.—The Central New York Telephone & Telegraph Company has let the contract for the construction of a subway under the Oswego Canal, in North Salina Street, this city. Seven 3-inch iron ducts will be laid.

RED CREEK, N. Y.—At a conference held here it was arranged to unite as one concern the Wayne-Monroe Telephone Company and the Ontario Telephone Company of Oswego. The Wayne-Monroe Company connects with the Inter-ocean Telephone Company, and by this service is enabled to reach Rochester, Buffalo, Ohio, Southern New York and Pennsylvania. In the Western New York system there are said to be 50,000 telephones.

REIDSVILLE, N. C.—The Reidsville telephone exchange has recently been remodeled and the system is now in fine working order with 150 telephone connections on the switchboard.

CHARLOTTE, N. C.—The Automatic Electric Company, of Chicago, has installed an experimental set of telephone instruments at Greensboro, N. C.,

which will be adopted in the proposed independent system, unless the present differences with the Bell Company are adjusted.

GREEN SPRING, OHIO.—The Green Spring Telephone & Electric Company has increased its capital stock from $20,000 to $35,000.

GREENWICH, OHIO.—The Fitchville Telephone Company is preparing to build a line into Greenwich to connect with the exchange at that place.

TOLEDO, OHIO.—The Central Telephone Company has been incorporated with a capital stock of $100,000. The directors are J. S. Brailey, H. A. Barber and others.

NORWOOD, OHIO.—The independent telephone interests that recently failed to secure a franchise in the village of Norwood are making an effort to secure the passage of their ordinance in an amended form.

JEWETT, OHIO.—Fred Patton, of this place, is building a number of farmers' lines throughout this district. He is preparing to build a new line from Jewett to Hanover and Stillwater. The lines will be connected with the exchange at Jewett.

NEWARK, OHIO.—The Central Ohio Telephone Company, of Centerburg, Knox County, has been incorporated by Charles L. Bishop, T. P. Sylvan, E. E. McGuire, J. E. Litzenburg and G. N. Jackson. Capital stock, $10,000. It will build an exchange at Centerburg with lines in Morrow, Licking and Delaware counties.

GUTHRIE, OKLA.—The Chickasaw & Choctaw Telephone Company, of Durant, has purchased the Hugo Telephone Exchange and the toll line, 25 miles in length.

TORONTO, ONT.—In discussing the fire situation at a special session of the Board of Control, action was taken with a view to placing all wires underground within the city.

DURKEE, ORE.—The Express Telephone & Telegraph Company has been incorporated by W. G. Ayre, F. S. Hub and F. L. Moore, to build a system in the Brunt River region.

WILLAMETTE, ORE.—The Willamette & Wilsonville Telephone Company has been organized and will incorporate to construct a line between Stafford and Oregon City. Mr. Charles Baker is president; G. H. Rogers, treasurer; F. C. Geery, general manager.

PHOENIXVILLE, PA.—The citizens of this place propose to organize a local mutual telephone company. Mr. William Ellis is one of the promoters.

EASTON, PA.—Mr. A. G. Dickson, of Philadelphia, special master, April 16, sold the system of the New Jersey & Pennslyvania Telephone Company to J. Davis Broadhead, of South Bethlehem, attorney for the bond holders, for $25,000.

SAN ANTONIO, TEX.—The Eureka Telephone Company is rebuilding its telephone line between this city and Fredericksburg. Its line between San Antonio and Alice has just been rebuilt.

AUSTIN, TEX.—The Texas Telegraph & Telephone Company, which owns and operates more than 600 miles of telephone lines in this part of the State will rebuild its lines between Burnst and Lampasas, a distance of about 25 miles. It will also make extensions of some of its other lines. At a recent meeting of the board of directors of the company held here, Col. C. C. Gibbs, of San Antonio, Tex., was re-elected president. He can give information in regard to contemplated improvements.

SALT LAKE CITY, UTAH.—The competitive war between the Rocky Mountain Bell Telephone Company and the Utah Independent Telephone Company commenced a few days ago when the management of the new company, which is now ready to begin business here and in Ogden, stating that it would utilize the same numbers now in use by the Bell Company. The manager of the Bell Company has protested, stating that the numbers are copyrighted and cannot therefore be lawfully used by the rival company.

RICHMOND, VA.—The Rural Retreat Mutual Telephone Company has been incorporated with a capital stock of $5000. Mr. John Killinger is president.

RICHMOND, VA.—The Patrick County Telephone Company, of Stuart, has been incorporated with a capital stock of $1,000 to $5,000. Mr. T. L. Clark is president.

KALAMA, WASH.—The Kalama Electric Light & Power Company will soon commence the installation of a telephone system.

PORT TOWNSEND, WASH.—The Citizens' Independent Telephone Company, of this place, has been incorporated with a capital stock of $10,000. The trustees are A. T. West, N. C. Strong, G. M. Parmlee, D. S. Troy and M. E. Harris.

BELLINGHAM, WASH.—The International Telephone Company is being organized here to build a connecting line between Bellingham and Victoria, B. C., through the San Juan Archipelago, a distance of 70 miles. The circuit will include 17 miles of cable costing $60,000.

ST. CROIX, WIS.—The St. Croix Mutual Telephone Company has been formed here.

MILWAUKEE, WIS.—The Milton & Milton Junction Telephone Company has increased its capital stock from $5,000 to $20,000.

ALMA, WIS.—The Tenney Telephone Company has been organized, Dr. J. S. Tenney being president and J. Accola, secretary.

MILWAUKEE, WIS.—The Great Western Telephone & Telegraph Company has decided to dissolve. Mr. Charles Webster is president and Robert C. Brown, secretary.

WILLOW SPRINGS, WIS.—The Willow Springs Farmers' Telephone Company has been incorporated with a capital stock of $4,000. The directors are Frank McCarville and others.

ELMWOOD, WIS.—The Highland Telephone Company, of Elmwood, has been organized to operate a system in Pierce and Dunn counties. The capital stock is $1000, and the incorporators are H. A. Miles, W. H. Young, Hugh Bell, Ira J. Smith and William Fensenmaier.

ELECTRIC LIGHT AND POWER.

MORENCI, ARIZ.—It is reported on apparently trustworthy authority that the Arizona Copper Company is interested in a project to establish a large electric power plant on the Blue River for the purpose of furnishing lights and power for this mining camp and town.

MALVERN, ARK.—Mr. C. W. Turner, proprietor of the electric light plant in this place, proposes to install a new dynamo and boiler.

SANTA PAULA, CAL.—The Santa Paula Electric Company proposes to extend its lines for the general distribution of light and power.

ALTURAS, CAL.—The Alturas Electric Light & Power Company has been incorporated with a capital of $20,000, by D. E. Mulkey and I. W. Gibbons.

OAKLAND, CAL.—The Oakland Electric Company will develop a second water-power station having a capacity of 15,000-hp, and will also install 750-hp steam plant during the next year. Tae orobable cost of these improvements will be about $100,000.

MARTINEZ, CAL.—The Contra Costa Electric Light Company proposes to extend its lines to Concord, a distance of seven miles. The company purchases its current from the California Central Gas & Electric Corporation of San Francisco and has the city contract for street lighting, besides doing commercial lighting.

SAN FRANCISCO, CAL.—After a delay of many months the Mutual Electric Light Company of San Francisco, has given orders to at once construct the new electric power station at the intersection of Spear and Folsom Streets, covering a lot 137½ feet square. The machinery for the initial installation of 5,000-hp is on hand with the exception of the boilers. Additional boilers will be ordered, although the company has six Heine boilers at its present plant at Howard and New Montgomery Streets. This station will be abandoned. The equipment of the new plant will include two generating units each consisting of a 2,500-hp Pennsylvania Iron Works horizontal compound engine, direct connected to a Bullock 1,500-kw 2-phase generator. Current will be supplied at 2,200 volts. Additional boilers can be placed on the upper floors of the station, and by utilizing all of the ground available the capacity of the plant can be increased to 40,000-hp. Oil fuel will be used. A bond issue of $400,000 is to be authorized at a shareholders' meeting June 21. E. H. Rollins & Sons, of San Francisco and Boston, have agreed to purchase the bonds to the amount of $250,000.

GRAND JUNCTION, COL.—The Grand Junction Electric & Gas Company has doubled the capacity of its plant during the last three months. Mr. Charles S. Newton is manager.

GLENWOOD SPRINGS, COL.—The Colorado Power Irrigation Company, Denver, has purchased a water right about 12 miles above Glenwood Springs on the Grand River.

WATERBURY, CONN.—Bids will be received by Jas. Knox Taylor, supervising architect, Treasury Department, Washington, D. C., on May 26 for the installation of a conduit and electric wiring system for the U. S. post office at Waterbury.

BLAKELY, GA.—The water and electric light plant owned and operated by the city was destroyed by fire April 15.

THOMASVILLE, GA.—The town authorities have under consideration the construction of water works and an electric light plant.

BLUE RIDGE, GA.—The Blue Ridge Electric Light & Power Company contemplates making some extensive improvements to its system in the near future. It is proposed to utilize water power for the generation of current for electric light and power. Mr. E. B. Garwood, of Blue Ridge, is manager of the company.

LEWISTON, IDA.—Francis Jenkins, of Moscow, has purchased from John O. Bender, of Lewiston, the water right at Elk Creek Falls, about 50 miles from here. Mr. Jenkins will organize a company to develop an electric power there for running electric railways and light plants, grist and sawmills, and manufacturing plants of various kinds. A survey of the falls shows that 3,000-hp can be generated.

MOUND CITY, ILL.—Chas. Cureen is about to petition the City Council for a franchise to install and operate an electric plant here.

CHICAGO, ILL.—Mayor Harrison, in his annual message to the Council, urges the passage by the next Legislature of a law to enable the city to own gas and electric light plants.

CARTHAGE, ILL.—The Carthage Electric Light & Heating Company has changed its name to Carthage Electric Light & Power Company, and increased its capital stock from $20,000 to $50,000.

ELGIN, ILL.—The Fox River Light, Heat & Power Company has absorbed by purchase the Aurora, Elgin and Chicago Light & Power Company to avert a rate war.

FREEPORT, ILL.—The Pecatonica River Power Company has been incorporated with a capital of $5000, to operate electric lighting, railway and power plants. Incorporators: Henry B. Witte, Jos. H. Vincent and Chas. B. Courtney.

NEW HAVEN, IND.—Bids are wanted May 24 for constructing an electric light plant. John M. Jackson is Town Clerk.

GRETNA, IND.—The Jefferson Ice & Electric Light Company will enlarge the capacity of its plant in order to light the towns of Gretna and McDonoughville, if the contract can be secured in these towns.

SOUTH BEND, IND.—The South Bend Electric Company, F. A. Bryan, manager, is erecting a sub-station in South Bend from which power will be distributed from the Twin Branch Dam of the St. Joseph & Elkhart Power Company and the Buchanan dam of Mr. C. A. Chapin.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company is building a new power plant with a capacity of 800-kw., all direct connected

units. The new plant will cost $150,000 and will be ready for operation July 1 next.

MARION, IND.—A bitter political fight is being waged in this city, the issue being a franchise for an electric light and heating company. The council is being charged with an intention of conspiring to sell the municipal electric light plant to the Marion Light & Heating Company which has a monopoly in commercial lighting and heating. An injunction suit has been filed to prevent the city officials from disposing of the municipal plant.

NOBLESVILLE, IND.—All bids for the contract to light this city for ten years were rejected because they were filed twenty minutes after 7 o'clock, April 19, the time advertised. It is thought that the council took advantage of this slight omission in order to enable the Noblesville Hydraulic Company, which is building a dam across White River for the purpose of furnishing electricity to Noblesville, to submit a bid. The company could not bid at present, owing to some cases pending in the Supreme Court, but will be ready to submit a bid any time after June 15. Bids will be re-advertised.

SPRINGFIELD, KY.—The Springfield Water & Electric Light Company is making large extensions to its system.

PADUCAH, KY.—The Board of Public Works has decided to improve the electric light plant.

NEW ORLEANS, LA.—Notwithstanding the acceptance of the lighting bid of the New Orleans Railroad & Power Company for furnishing electric power for illuminating in this city, it is positively stated by President Dreyfous, of the Consumers Electric Company that the building of its plant will begin at an early date.

NEW ORLEANS, LA.—Comptroller Tujague, on April 18, sold the municipal lighting franchise at public auction to the New Orleans & Carrollton R. R., Light & Power Company, the lowest bidder. The figures were $69 per lamp for the overhead lamps; $85 per lamp for the lamp fed by the underground system, and 6 cts. per kw-hour for the incandescents and other lights used in the public buildings.

LAKE CHARLES, LA.—The Lake Charles Ice, Light & Water Works Company contemplates the addition of a 300-kw generator, a 100-light station transformer and 50 alternating current series arc lamps. Mr. J. A. Landry is president and manager of the company.

SPRINGFIELD, MASS.—The United Electric Light Company will install a 100-kw steam turbine about the 1st of October next.

BALTIMORE, MD.—Bids will be received by the Board of Awards until May 11 for installing and maintaining electric lights in Druid Hill Park. W. W. Crosby is general superintendent of the Park Commissioners.

BALTIMORE, MD.—The Maryland Telephone & Telegraph Company has had introduced in the council a new ordinance for electric lighting privileges. The original bill was vetoed by the mayor. It is claimed that the Maryland Company has in the new ordinance met the objections of the mayor.

GERARD, ILL.—The Gerard Electric Light Company is in need of a larger alternating current generator. Mr. H. L. Wares is superintendent and chief engineer. The plant is operated by the municipality.

WATERVILLE, ME.—The Ft. Halifax Power Company has been organized at Waterville to construct an electric light and power plant in Benton and Winslow; capital, $250,000. Harvey P. Eaton, of Waterville, president and treasurer.

PAW PAW, MICH.—The village electric light plant will be entirely renewed in the near future.

ZEELAND, MICH.—The Zeeland Water & Light Company will probably install a 15-kw direct-current, 250-volt marine set before next winter, for use after midnight.

BREWSTER, MINN.—The Village Board has under consideration the construction of an electric plant.

CANNON FALLS, MINN.—Bids are wanted May 14 for installing a power plant on the Cannon River near this village. Approximately 10,000 cubic yards of concrete, three horizontal, direct connected water wheels, operating under 46 ft. head and generating 1575-kw at 30,000 volts, with three generators, step-up transformers, switchboards, oil switches, etc. Address G. S. Edmonstone, chief engineer, 518 Globe Bldg., St. Paul.

STARKVILLE, MISS.—The municipal electric light plant is being enlarged to about twice its former capacity.

SEDALIA, MO.—The Sedalia Water & Light Company will build an entirely new plant during the coming summer.

SANFORD, N. C.—The Sanford Electric & Power Company will extend its lines to Jonesboro, N. C., a distance of two miles and add 500 lights to the service.

CONCORD, N. C.—The municipal electric light plant will be changed over to alternating current during the next 12 months, and new equipment will be installed, including 60 arc lights and 1500 incandescents, with suitable machinery for the service.

COOPER, NEB.—The electric light plant at this place was destroyed by fire April 18. Mr. W. T. Martin, the proprietor of the plant, will rebuild at once. In the meantime the town is in darkness.

PRINCETON, N. J.—Richard Stockton has been appointed receiver for the Princeton Light & Power Company. It is stated that the assets of the company are $400,000 and the liabilities about $600,000.

ASBURY PARK, N. J.—The Atlantic Coast Electric Company is building another new circuit to Spring Lake, a distance of six miles. The circuit will be operated only by day during the months of May, June, July, August and September.

JERSEY CITY, N. J.—The Street and Water Board has granted permission to the United Electric Company, of New Jersey, which is now included in the Public Service Corporation, to construct subways for electric light, heat and power wires in certain streets of this city.

CHATEAUGAY, N. Y.—The Chasm Power Company proposes to build a line to Burke, N. Y., a distance of five miles, for the extension of its light and power service.

NIAGARA FALLS, N. Y.—It is stated that the Ontario Power Company contractors on the Canadian side of the river are experiencing considerable difficulty with land slides. Hardly a day passes that there are not one or more slides of land in the wheel pits and in the long trench of the Company. The trench now contains a large quantity of earth thus deposited, which will be removed as soon as the weather permits.

WILMINGTON, OHIO.—The Wilmington Water & Light Company is building an entirely new plant, to be completed by September next.

TOLEDO, OHIO.—Mayor Jones in his annual message advises Council to empower the Board of Public Service to advertise for bids for installing a 2000-arc light lighting system to be paid for by the city without a bond issue.

BELLAIRE, OHIO.—The Belmont Electric Light & Power Company is planning additions and improvements to the power plant that will almost double its capacity.

COLUMBUS, OHIO.—Bids will be received May 31 by the Board of Trustees of Ohio State School for the Blind for furnishing and installing one 200-hp water-tube boiler; two 100-hp tubular boilers or four 100-hp tubular boilers. H. P. Crouse is president.

MEAFORD, ONT.—Messrs. W. Moore & Sons, proprietors of the electric light plant, are developing a water power with a capacity of about 400 horsepower.

KLAMATH FALLS, ORE.—The Klamath Falls Light & Water Company will install a gasoline engine to take care of the increasing demand for its service.

SUMPTER, ORE.—The Sumpter Light Water Company will, about July 1 this year, change its power from steam to water.

CORRY, PA.—A new power house for the Corry City electric light plant is contemplated.

MECHANICSBURG, PA.—The United Electric Company is rebuilding and reconstructing its plant and installing new equipment.

EASTON, PA.—The directors of the People's Electric Light & Power Company have re-elected Dr. Evans as president; Mr. Osterstock, treasurer, and Mr. Ormsby, secretary.

CHRISTIANA, PA.—Mr. A. J. Melchen, owner of the electric light plant here, proposes to extend his system in order to take in three towns and farmer districts.

LANSDALE, PA.—The equipment of the municipal electric light plant in this place will be extended during the present year by the addition of one 120-kw alternating current machine, one 250-hp Corliss engine and one boiler.

IROQUOIS, S. D.—The electric light plant of this village is operated by the municipality. The power is furnished by a "Little Giant" turbine. The management contemplates putting in a second dynamo in order to avail of all the power of the water wheel. The chief engineer of the plant is Keefus Bartain. Mr. Charles E. Cameron is chairman of the commissioners.

ENID, IND. TER.—The Chickasha Electric & Gas Company has been incorporated with $45,000 capital. The incorporators are J. M. Dodson, H. H. Watkins and J. B. Thieme.

CALDWELL, TEX.—An electric light and power plant is to be established here. The Business Men's League can give information in regard to the project.

SAN ANTONIO, TEX.—Bids are wanted May 10 for installing a system of electric light wiring and fixtures in U. S. Court House and Post Office here. Address H. A. Taylor, Assistant Secretary Treasury Department, Washington, D. C.

BLACKSBURG, VA.—The Virginia Polytechnic Institute will increase the capacity of its electric plant to about three times the present size.

MARTINSVILLE, VA.—The town of Martinsville contemplates installing an electric light and power plant with a capacity of 1000-hp, to be operated by the town. Besides the lighting system, power will be sold for industrial purposes. The water power of Smith River, at a point one mile south of town, will be utilized. Engineers are now on the ground making surveys and estimates. Mr. A. L. Scott, representing Lockwood & Green, of Boston, Mass., is the engineer in charge.

MONROE, WASH.—The Monroe Water & Light Company recently organized will install a water system and an electric light plant.

FT. WRIGHT, WASH.—Bids are wanted May 31 for lighting the post with electricity; separate bids are wanted for the apparatus. Address Capt. W. C. Wren, Constructing Q. M., Vancouver Barracks.

MILTON, WASH.—Engineers for the Oregon & Washington Power Company are at work on a site for the power plant on the South Fork of the Walla Walla River near this place. It is expected to have the plant in operation by October 1 and to furnish light and power throughout the section of country between Walla Walla, Wash., and Pendleton, Ore. The company bought up the Walla Walla Electric Light Co. and the Pendleton Electric Light & Power Company, and is financed by Philadelphia capital.

IRON RIVER, WIS.—The Iron River Water, Light & Power Company will install a water power in the near future.

WITTENBERG, WIS.—Bids will be received May 9 by John England, village clerk, for constructing an electric light plant.

OSHKOSH, WIS.—The property of the Oshkosh Electric Light & Power Company is to be taken out of the hands of a receiver in the near future and sold on foreclosure. It is stated that the plant is now on a paying basis and the services of a receiver can be dispensed with.

THE ELECTRIC RAILWAY.

HOT SPRINGS, ARK.—The Hot Springs Street Railway will be extended and a number of improvements made to the property. President S. W. Fordyce, Chemical Building, St. Louis, has the matter in charge.

NANAIMO, B. C.—Mr. C. Brandeis has asked for a charter for an electric street railway system; also a line between Nanaimo and Bracken in the newly discovered coal fields. It is proposed to derive power from the Nanaimo River Falls. Mr. Brandeis represents a Montreal syndicate.

WALLINGFORD, CONN.—The Wallingford Tramway Company will at once begin the construction of a line from this borough to Montowese, in the town of North Haven, where connections will be made for New Haven with the Fair Haven & Westville Railroad Company. The road will be 7 miles long, and the materials for it have been ordered.

DENVER, COL.—The Chaffee County Electric Light, Power & Railway Company has filed articles of incorporation with the Secretary of State. The company, which is capitalized at $500,000, is empowered to furnish electric power and construct street railway lines in Salida and its suburbs, and also to the towns of Buena Vista, Turret and Poncha Springs. Former United States Senator William E. Mason of Chicago, Ill., and T. F. Mason of Des Moines, Ia., will be prominently identified with the concern.

HOSCHTON, GA.—John R. Hosch, W. P. Dela Perriere, R. A. Hosch, J. E. Hill, H. J. Sill, G. Brasleton and L. F. Sill will apply for a charter to build an electric railway through Stone Mountain, Logansville, Hoschton, Jefferson, Commerce and Barnesville.

TOPEKA, KAN.—The Kansas City, Olathe, Lawrence and Topeka Railway Company has been incorporated here with a capital of $1,000,000 to build an interurban line between Topeka and Kansas City.

LEXINGTON, KY.—The Lexington & Suburban Railway Company has been chartered with a capital of $250,000, to build a 25-mile line from Mayview to Henry. Gustav Haerle, of Lexington, is interested.

EMMETT, IDA.—E. H. Dewey, of Nampa, is interested in a proposed electric railway between Emmett and Pearl.

LEWISTON, IDA.—W. H. Hill, chief engineer of the Lewiston & Southeastern Electric Railway, which is planned to run between Lewiston and Grangeville, states that surveys are completed and rights of way obtained, and that the work will begin at once. The line will be 86 miles long.

SPRINGFIELD, ILL.—Articles of incorporation have been issued to the Springfield, Petersburg & Beardstown Interurban Railway Company. The home office is at Petersburg, and the stock is placed at $2500. The incorporators are John S. Hurie, James S. Miles and Robert Bone.

BEARDSTOWN, ILL.—The Springfield, Petersburg & Beardstown Interurban Railway Company, with home office at Petersburg, has been incorporated with a capital stock of $2,600,000. The incorporators are John S. Hurie, James S. Miles and Robert Bone.

GALESBURG, ILL.—The McKinley syndicate has completed all the plans for its new power house, but has not yet announced the location of the plant. It will have a capacity of 4000 horse-power. The cost of the building complete will be in the neighborhood of $200,000. Mr. Duncan, of the syndicate, states that it is more than likely no contract will be let for the construction of the building, but that the syndicate will superintend the work. Some time ago a contract was placed with the Hamilton-Corliss Engine Company for two 1500-hp engines, and the Bullock Electric Company and the General Electric Company were awarded a contract for two generators. The Sterling Boiler Company will furnish four 400-hp boilers.

WABASH, IND.—The Indiana Central Traction Company has increased its capital stock from $50,000 to $200,000. The increase of capital will enable the company to complete the construction of two lines which it is now building.

FORT WAYNE, IND.—A conductor on the Fort Wayne & Southwestern Interurban Railway was killed a few days ago in a peculiar manner. He was using a portable telephone carried on the car and, it is stated, received an electric shock which caused his death.

MUNCIE, IND.—W. H. Miller, of Bluffton; Mr. Bonham, of Hartford City, and W. H. Maxwell, of Boston, have asked for a franchise in this county for an electric railway to connect Alexandria and Hartford City by a direct route, and also a spur to run from Gaston to Stockport, and thence to Muncie. The road will be incorporated as the Oil Belt Traction Company.

COALGATE, I. T.—The Lehigh Traction Company, chartered to construct an electric railway from Atoka to Coalgate, has let the contract for building the road from Coalgate to Lehigh, a distance of 8 miles, to the Mutual Electric Company, of St. Louis. The company will also establish and operate electric lighting plants at Lehigh, Phillips and Coalgate, having already secured franchises for that purpose. The power house will be established at Phillips, which is half way between the two terminals.

OELWEIN, IA.—The Oelwein & Hazleton Construction Company has been incorporated with $10,000 capital stock to build an electric railway to Hazleton, 8 miles in length.

PITTSFIELD, MASS.—Arthur H. Rice, of this city, has been elected president of the Hoosac Valley Street Railway Company. The directors will petition for authority to increase the capital stock by $100,000, making a total of $500,000, and to issue bonds to the amount of $300,000, making a total of $400,000.

BEVERLY, MASS.—The company that will build the proposed electric railway between Beverly and Haverhill will be known as the Beverly & Haverhill Street Railway Company. The capital stock of the company will be $20,000. The directors of the company are to be Joshua Hale, John Balch Blood and Albert W. Rantoul, of Newburyport; Clifford B. Bray, A. C. Lunt, Louis L. Dodge and John H. Moore, of Beverly, Mass.

BANGOR, ME.—The contract for the construction of the Rockland, South Thomaston & Owl's Head Electric Railway has been awarded to Michael Sorretto, of Boston. Howard C. Forbes, 4 State Street, Boston, Mass., is chief engineer.

FOXCROFT, ME.—The Railroad Commissioners have approved the petition of the directors of the Dover, Foxcroft & Sebec Lake Railway Company, of Foxcroft. The capital stock is $30,000. The directors of the company are I. L. Dickinson and George W. Taylor, of Lexington, Mass.; H. L. Jones, of Boston; A. H. Stanhope, of Dover; W. E. Parsons, A. W. Gilman, Willis S. Ham, of Foxcroft.

TRENTON, N. J.—The East Jersey Street Railway Company has been incorporated at Trenton with an authorized capital of $500,000 to absorb the East Jersey Traction Company, the Raritan Traction Company and the Perth Amboy Railroad.

TRENTON, N. J.—The Chicago & Oak Park Railway Company has been incorporated here with a capital stock of $9,200,000, of which $6,000,000 is common stock and $3,200,000 preferred. This company is organized to take over the property and franchise of the Chicago & Oak Park Railroad Company. The incorporators are Charles A. Boston, West Orange; William R. Sainsbury, Brooklyn, and John G. Quincy, Bronxville.

CORTLAND, N. Y.—The Cortland & Homer Traction Company is said to be considering the advisability of extending its line from Little York to Tully.

ALBANY, N. Y.—The Cohoes Railway Company has been incorporated with a capital stock of $120,000. This is a reorganization. The directors are J. N. Wallace, New York; Thomas I. Van Antwerp and Eugene Crawford, Albany.

TOLEDO, OHIO.—A new electric railway is projected between Toledo and Jackson. Stephen A. Foster, of Toledo, is general manager of the promoting syndicate.

KANE, PA.—The Ridgway Trolley Company is stated to be interested in the building of an electric railway between St. Mary's and Sheffield.

MEDIA, PA.—Indications now point to the early building of the Philadelphia Morton and Swarthmore Street Railway from Darby to Media.

BELLEFONTE, PA.—The Phillipsburg Electric Street Railway Company has decided to extend its line from Phillipsburg to Osceola Mills.

BERWICK, PA.—C. W. Miller, of Bloomsburg, states that the early building of an electric railway between Berwick and Nanticoke is an assured fact.

JOHNSTOWN, PA.—Surveyors are at work on the final survey for the Conemaugh Valley Railway Company line, which will connect Johnstown and Ebensburg. The right of way has been secured for the entire distance.

LEBANON, PA.—G. S. W. Brubaker, of Lancaster, has the contract to build the Hummelstown & Campbellstown Electric Railway. For the present the line will extend from Palmyra to Hummelstown.

ALLENTOWN, PA.—The Hanover Central Electric Street Railway Company has asked Bethlehem Council for a franchise. The company contemplates building from Bethlehem to Catasauqua, with a spur into Allentown.

CARLISLE, PA.—The Steelton, New Cumberland and Mechanicsburg Trolley Company has closed contracts for four 200-kw generators, four 350-hp Corliss engines and four 400-hp tubular boilers. Contracts for the rest of the equipment have also been made.

DONORA, PA.—The franchise ordinance of the Donora & Carroll Street Railway Company has been passed by the Council. The company has reorganized and elected Bert W. Castner, president, and Attorney O. S. Scott, secretary and treasurer. The officials are now securing rights of way.

FAYETTE CITY, PA.—The Buena Vista power plant of the Pittsburg, McKeesport & Connellsville Electric Railway, purchased by the Webster, Monessen, Belle Vernon & Fayette City Street Railway Company, has been dismantled and shipped to Belle Vernon, near which place it will be erected.

SAYRE, PA.—The Sayre Trackless Trolley Company, capital $60,000, has been organized with these officers: I. A. Williams, president; Louis Eighmey, vice-president; H. S. Winlack, secretary, and J. T. Corbin, treasurer. The plan of the company is to build here a line of trackless trolley as developed by the American Trackless Trolley Company, of Boston.

BEAUMONT, TEX.—It is reported that the street railway system of the Beaumont Traction Company has been purchased by an Eastern syndicate which is negotiating for systems of street railway in other cities of Texas. The new owners will, it is said, make additions and improvements to the local system.

TEMPLE, TEX.—The Belton & Temple Traction Company will build eight miles of line between Belton and Temple, and lines in both cities, making about 12 miles of line in all. Plans and specifications of the road are now in the hands of J. C. Hauser, of Lewistown, Pa., secretary of the company. The officers of the company are Samuel Watt, of Belleville, Pa., president; A. F. Bentley, of Temple, first vice-president; A. C. Mayes, of Lewistown, Pa., second vice-president; J. C. Hauser, of Lewistown, Pa., secretary and attorney; Calvin Green, of Lewistown, Pa., treasurer.

RICHMOND, VA.—The Traction Development & Securities Company, of New York, has recently closed a contract with the Citizens' Rapid Transit Company, of Richmond, Va., to build 10 miles of railway in the city of Richmond. The office of the company is at 74 Broadway, New York.

FAIRMONT, W. VA.—The Fairmont-Mannington Electric Railroad Company has organized with the following officers: T. W. Fleming, of Fairmont, president; Jesse T. Koen of Mannington, vice-president; Allison Sweeney, of Fleming, secretary; Charles E. Manley, treasurer.

CONWAY, WASH.—The Conway Electric Street Railway Company has filed a petition with the Railroad Commissioners asking for the right to increase its capital from $36,000 to $116,000.

EVERETT, WASH.—A franchise to build an electric railway from Snohomish to Cherry Valley has been granted to W. M. Snyder and associates by the County Commissioners. The same persons have applied for permission to build a line from Snohomish to Lowell.